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# TELEPHONE ENGINEER

VOLUME 27 AUGUST, 1923 Number 8

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# TELEPHONE ENGINEER

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VOLUME 27 AUGUST, 1923 Number 8

## AN INDEPENDENT FOUR AND ONE-HALF PER CENT

A telephone engineer of wide experience in a recent letter to this paper suggested that there should be something in the Independent side of the telephone industry equivalent to the service which is rendered within the Bell system and for which is made the payment of four and one-half per cent of the gross revenue of the operating company.

This Bell license contract has been the subject of extensive investigation by public service commissions and other regulatory bodies, and volumes of testimony have been put into the records to show the nature and value of the service rendered under it. There are wide differences of opinion as to the fairness of the method of payment and the amounts paid under the contract, but no one will question the fact that service of very great value is being rendered by the parent company under the arrangement.

Certain of these services are of little interest to independently owned companies. These companies purchase outright the transmitters, receivers and induction coils. Few of them require repeaters or loading coils. Royalties and development costs on equipment are paid in the price of equipment. On the other hand, the Bell operating companies have available services of a legal, financial, accounting and technical nature that can be obtained only in a limited way or not at all by Independent companies.

In many cases, special studies which were beyond the limit of the financial or technical ability of the license companies have been made by the general organization, especially where the results were of importance to the whole industry. Work of correlating engineering practices and of standardizing construction methods and equipment is performed by the general organization. Advice and assistance in the preparation of financial programs and in marketing securities is an important part of the work of the parent Bell company. On the Independent side of the industry, no body performs these services and the companies are operating under a certain handicap, because of that fact.

The logical way of securing these services is through association. Associations in many lines of industry maintain central headquarters with legal, financial, accounting and engineering staffs. This could be done in the telephone industry and is a legitimate form of development of association activities.

Before this can be done, however, the associations must be financed in some way other than by the present "pass-the-hat" method. The Bell license revenue in 1921 was slightly over $2.00 per station. Our guess is that associations received less than five cents per station, per year. A strong association with a properly manned staff and supported by even one-half of one per cent of the gross revenue of the Independent telephone industry could do wonders.

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## SUPREME COURT OPINIONS ON VALUE AND RETURNS

The Supreme Court decision in the Southwestern Bell case continues to be a subject of much interest in the telephone world. Naturally, first attention was paid to the majority opinion, but more recently the minority opinion of Mr. Justice Brandeis has been subjected to close analysis. Mr. N. T. Guernsey in a recent number of "Bell Telephone Quarterly" points out a number of significant statements in the argument of the dissenting opinion.

It should be noted that the court was unanimous in deciding that the case should be reversed because the rates established were confiscatory. The dissenting opinion, dealing with the value and fair rate of return, would substitute the amount prudently invested as the rate base and would use the amount of the capital charge as the measure of the rate of return. It also comments on the distinction between a reasonable rate and a rate that is merely compensatory. It says what the Constitution guarantees is not a fair return but the opportunity to earn a fair return.

One of the things in the dissenting opinion that must be given careful consideration is the refer-

ence to the fact that the rule of present fair value and present fair return may work both ways and may subject investors to heavy losses when the price trend is downward. This consideration will justify careful attention to economy in construction costs at the present time and to the conditions under which long-time financing is done.

Commenting in a brief footnote on the case of Georgia Railway and Power Co. et al vs. Railroad Commission of Georgia, et al, in which the court refused to reverse a case in which the cost of reproduction had been considered, but not closely followed, Mr. Guernsey has the following to say: "This case, with the Southwestern Bell case and the Bluefields Water Works and Improvement Co. case, sharply brings out the fact that while cost of reproduction is a factor that must be taken into account, it does not furnish an arbitrary measure of the value of a utility."

## HOW MUCH IS A MANAGER WORTH?

Recently we had occasion to look over the analysis of revenue and expense of a number of telephone operating companies. The figures for two companies which stood side by side in the report were in some respects so similar and in other respects so different that they engaged our attention. Company A had 2,421 stations, $28.84 gross revenue per station, $24.78 expense per station and $4.06 net revenue per station. Company B had 2,419 stations, $25.38 gross revenue per station, $20.97 expense and $4.41 net revenue per station.

Among the items going to make up the expense, we found for Company A, $0.18 salaries, $3.94 taxes and uncollectible accounts. For Company B, $2.60 salaries and $1.05 taxes and uncollectible accounts. All of these figures were per station. Census reports gave the population of the city in which Company A operates as 9,293 and that in which Company B operates as 9,901.

At first sight we thought that the wide difference in the amount of salaries might be due to a difference in classification between salaries and wages, but we found that Company B also reported more for wages than Company A. As far as other accounts were shown in the analysis, there was a reasonably close check between the two companies.

## OUR PRESIDENT PASSES

In the loss of Warren G. Harding, the telephone industry sustains a bereavement that is personalized beyond the sorrow the nation generally feels upon the death of an able, sincere, and diligent leader.

The President was associated with the telephone company in his home town. As one ever active in promoting public advancement and service he found in the telephone industry an inviting field for the consummation of his public-spirited hopes. The telephone meetings in Ohio knew him as a frequent attendant, and an astute counsellor.

Time's verdict probably will laud the late President as one whose unremitting labors and wisdom guided the nation through perilous channels.

But his fellow public servants left behind, shall not wait in pronouncing judgment. Their "Well done, good and faithful servant" is the tribute that our lamented President would have considered glorious and complete.

We have never seen the properties and know nothing of the conditions under which they operate. Reasoning from the figures alone, it seems that the company which was expending the larger amount for salaries of supervisory staff is making a better showing than the one which shows practically no expense for salaries. With $3 less revenue per station, its net earnings are greater. Since the item of taxes can account for only part of the difference between the two companies, it is probable that the uncollectible accounts in one case were very much larger than in the other. Apparently, the company with an adequate staff was making its collections while the other was not.

This comparison may throw some light on the question frequently asked: "How much should a telephone company pay for management and supervision?" One company seems to be getting a splendid return on the amount that it is paying for these services. The showing of the other indicates that it is getting the services only about in proportion as it pays for them.

## TEAMWORK IN INDUSTRY

When the eighty or a hundred players in a modern orchestra under the direction of a competent conductor are playing the music of a master composer, the listener gets the effect of a single musical instrument. Balance, precision and unanimity are achieved to such a remarkable degree that the notes of each instrument or section melt into the whole melody. The tone flows forth so freely, spontaneously and smoothly that the efforts of no individual player are apparent.

So delicate is the mechanism of a great orchestra that a single incompetent or over-ambitious player may mar the quality of the entire performance. It is only when the desire for individual achievement is submerged in the general glory that the triumph of a master performance is attained.

In spite of the fact that some ill-informed persons would have us believe that art and industry are at opposite poles of the earth, it would seem that a great orchestra might be made the ideal for which an industrial organization should strive. Industry has grown beyond the stage of individual work and must depend upon co-ordinated effort. It is this co-ordination of effort which we have come to know by the expressive, if not particularly elegant, name of "teamwork," that produces the results.

# LINE AND DESK

## SMALL BITS OF WASTE AMOUNT TO BIG TOTAL

We can best save material by taking the shortest and best route to a subscriber's premises. By so doing, we can economize on wire and attachments.

Do not cut off ten or fifteen feet more of wire than you need for the job. By doing so on fifty jobs, enough wire is wasted to complete the average work order. If the wire is two or three feet longer than is required to reach the protector or terminal, cut it off in one piece so that it may be used for a tie. If cut off in two pieces, it is too short for any use and has to be thrown away.

When dead-ending wire on a crossarm or pole, two wraps are sufficient to cut the line straight through. Waste will eventually amount to a coil of wire.

If you should come into contact with trees when stringing your drop, be sure to put molding on. This will save wire and time.

In taking down good wire, roll it up neatly in a coil so that it can be used again.

When running inside wire, conceal it in the walls wherever possible. By so doing, you save on milonite nails.

If an inch and a half screw will hold the subset on the wall, use it instead of a longer screw.

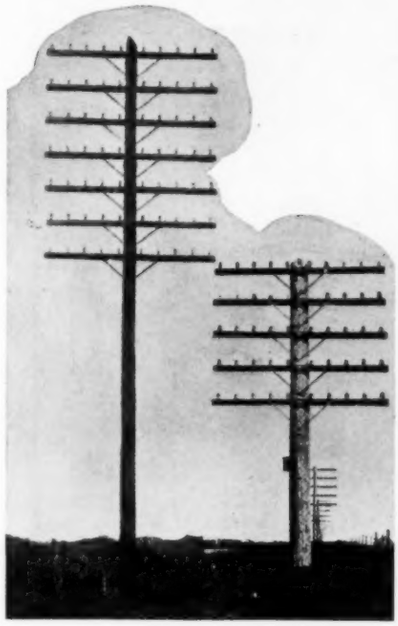
In running ground wire, use all means of fastening it to a water pipe, which will require the use of a small clamp, instead of a ground rod, the later being the more expensive.

When wrecking old leads, lower good material on a hand line to prevent breakage. Small material, if thrown down, is easily lost.

Carry small material, such as sleeves, fuses, carbons and insulators, in containers so they will not become bent, broken or lost. Think what it would mean in a year if each of us lost one of these articles a day. One employer losing one sleeve a week would mean a half a box a year.

A little thought in beginning your day's work will mean a saving in the end. Tomorrow, pay attention to the material you waste and think what it would amount to in a year.—J. L. Kinsman, in "The Mouthpiece."

*THEN AND NOW IN POLE LINE CONSTRUCTION*



***This picture reproduced from "Southwestern Telephone News" illustrates how ideas of toll pole-line construction have changed in recent years. The pole at the left is forty feet long while the one at the right is twenty-five. This change means not only reduced first cost but gives a stronger line and one that will give less trouble***

## *Plane Crashes Into Toll Line—New Trouble from Air*

St. Paul, Minn.—A new source of misery for the telephone line gang has appeared from the sky. A plane piloted by a student flier crashed into a maze of telephone wires near the Curtis flying field here and ripped down a score of wires constituting one of the main toll leads. In making a landing, one of the wheels of the plane caught on a telephone wire. The plane was swung completely around, both wings were torn from the plane and the motor flung from the fusilage.

***ACCIDENT PREVENTION HINT***

***A few minutes spent in mending a borrowed ladder may save a few weeks in a hospital.***

## POISON IVY.

At this time of year, Safety Departments are again calling attention of the outside men to the dangers of ivy poisoning. Most men know how to recognize the poison vine by its three leaves and to distinguish it from the harmless five-leaf vine. The best first-aid measure in case of contact is probably a thorough washing of the affected parts. Plenty of soap and water, preferably hot, making a heavy lather and changing the water several times is an excellent preventative of poisoning. Washing in gasoline is also effective. In case the poisoning develops, a competent physician should be consulted. Home treatment may not be effective.

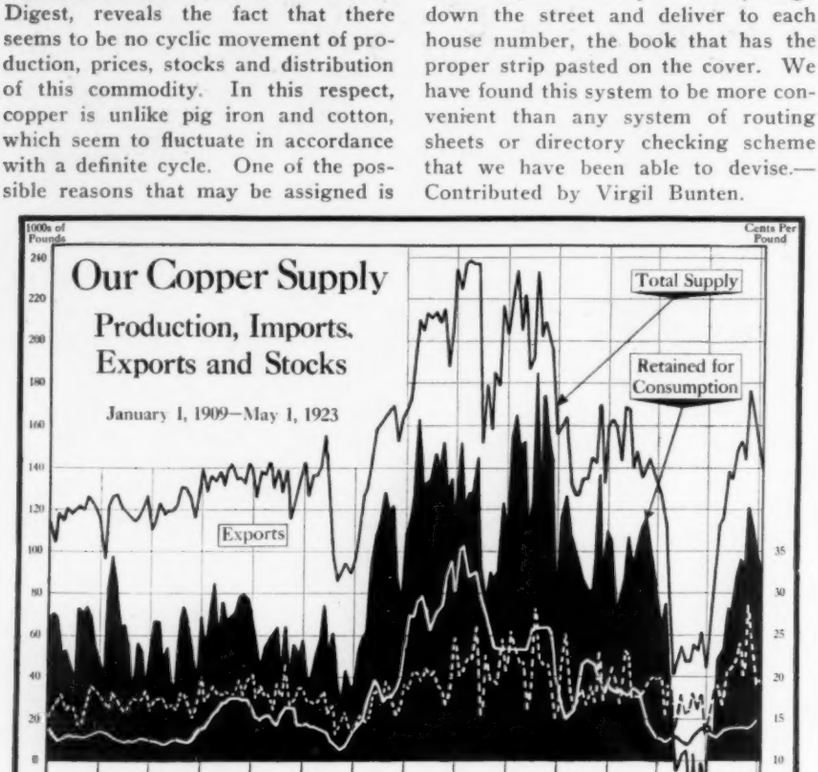
Men who have to work where they come into contact with poison ivy should wear heavy gauntlet gloves and, after the work is finished, the gloves and outer clothing that may have come into contact with the vine should be washed thoroughly in soap and hot water. This will prevent carrying the dust and poison particles to other parts of the body.

## MORE BRAINS AND LESS BRAWN IN DRIVING SCREWS.

The other day, I watched a big lineman laboring over the job of driving a screw to hold a house knob for a drop wire. Finally, by throwing the greater part of his 190 pounds of brawn and muscle against the handle and using a lot of effort and language as well—he succeeded in driving the screw home. When he got done, I said: "Bill, let me see your screw driver." As I expected, the bit was a fine wedge which may have been good for something but which did not fit into the slot in a screw head. There happened to be a public garage in the block and Bill and I went down and borrowed the use of the grinding wheel from the mechanic in charge. We dressed down the screw driver blade until the two sides were parallel and went back to the job. After trying the screw driver on a couple of more screws Bill said: "No brains; I've been cussing that screw driver when I ought to have taken a good kick at my own head."—Contributed.

## COPPER HAS NO PRICE CYCLE

A statistical study of the conditions in the copper industry since 1909, published in a recent number of Industrial Digest, reveals the fact that there seems to be no cyclic movement of production, prices, stocks and distribution of this commodity. In this respect, copper is unlike pig iron and cotton, which seem to fluctuate in accordance with a definite cycle. One of the possible reasons that may be assigned is that copper is more closely under control of the producers and the play of competition between many buyers and many sellers is not present in the same degree. A survey of present conditions indicate that production is now up to normal, while exports have been below corresponding months of 1913 and 1914. Copper prices were pushed up in the opening months of the year, but the demand was evidently insufficient to support the high quotations. At the present time the price is relatively low but no one can foretell the future course of the copper market with the paucity of data available.



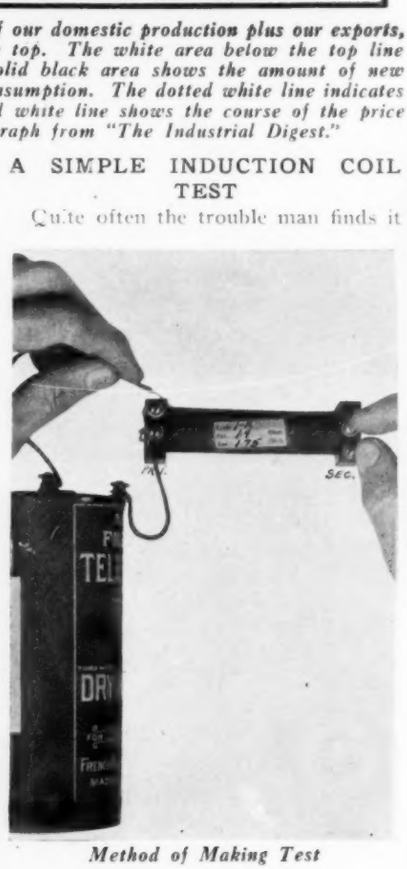

*Our total supply of new copper, made up of our domestic production plus our exports, is shown above by the black curve at the top. The white area below the top line represents our exports of copper. The solid black area shows the amount of new copper retained in the United States for consumption. The dotted white line indicates the volume of copper imported. The solid white line shows the course of the price of electrolytic, spot, New York—Graph from "The Industrial Digest."*

## A SUGGESTION FOR DIRECTORY DELIVERIES.

When our directory is being printed, we have the printer pull off a copy on gummed paper. This copy is then cut into pages and the pages are cut into strips so that each strip has the name, address and telephone number of one subscriber. The strips are then pasted to the front cover pages of the directories. The directories are then sorted by streets and the group for each street arranged in the order of the street numbers. In making the deliveries, it is merely necessary to go down the street and deliver to each house number, the book that has the proper strip pasted on the cover. We have found this system to be more convenient than any system of routing sheets or directory checking scheme that we have been able to devise.—Contributed by Virgil Bunten.

## A SIMPLE INDUCTION COIL TEST

Quite often the trouble man finds it necessary to test or check up on the condition of an induction coil. The simplest and most convenient way for him to do this is to connect one terminal of the primary winding of the coil to a dry battery and with a wire leading from the other side of the battery make and break contact with the other terminal of the primary winding, at the same time placing two fingers of the right hand on the terminals of the secondary winding. When the contact at the primary winding is broken a good shock will be felt and he may rest assured the induction coil is in good operative condition.



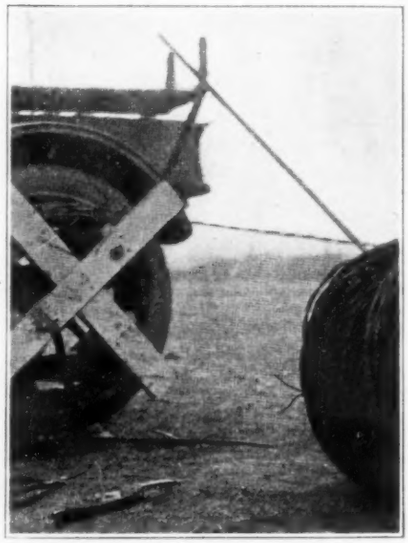

*Method of Making Test*

This test is much more efficient than a ring through or buzzer test because if either the primary or secondary winding is open, short or partially short circuited, a shock will not be felt at the terminals of the secondary winding. This simple test may be made without removing induction coil from the telephone. It is not even necessary to disconnect it, providing the receiver is left on the switch-hook. Try it.—"The Monarch Message."

## TRY THIS ON YOUR FORD

Section Lineman Lea Lamons, Vinita, Okla., and C. H. Wine, Joplin, Mo., produced the device shown in the photograph below. Their incentive, writes E. P. in "Long Lines," was an emergency caused by the burning down of three spans of the line at Fairland, Okla., followed by a cyclone.

Before they had taken the duplex out of the line and effected permanent repairs after the fire, a ten-pole break occurred about ten miles east of Carthage, caused by the cyclone. To save time, this labor minimizer was hurriedly improvised and used to good advantage, as it saved the company hours in lost circuit time.—Long Lines.



*The Ford Wheel Reel*

## Get Mexican L. D. Rights

Tampico, Mex.—Hilario Millan, Jr., Alejandro R. Mejia and others of Sonora and Sinaloa have obtained a concession for a long distance telephone service throughout the republic of Mexico. The initial capital will be not less than 500,000 pesos and will be used for the establishment of lines in the Federad District, Baja California, Puebla, Vera Cruz, Queretaro, Jalisco, San Luis Potosi, Nuevo Leon, Tamaulipas, Coahuila and Sonora. It is expected that later on the company will make connections with the United States. The concession stipulates that 20 per cent of the gross income will be paid to the government and that the entire plant will revert to the government at the end of certain number of stipulated years.

The contract also stipulates that the company may only install phone for commercial use in towns where there is no telegraph service. The principal offices of the company will be in Mexico City.

## Ericsson Going Strong

Stockholm, Sweden.—The L. M. Ericsson Telephone Co. and affiliated concerns' annual report gives the net profits of the head company for 1922 as approximately $600,000. A dividend of 5 per cent was declared. Among the subsidiary concerns the British company declared a dividend of 8 per cent, and the Finnish, 15 per cent. The works in Petrograd have been nationalized and are still in control of the Soviet. In Austria and in Hungary the Swedish telephone industry has been particularly active. In Vienna the capital stock has been increased from 3,000,000 Austrian kronen to 150,000,000, and last year's dividend on the new capital was 50 per cent on the old capital. The Warsaw company has increased its equipment to 37,000 instruments, and last year's business showed good returns. The Ericsson-Mexico system now has nearly 17,000 subscribers, and the dividends were 12 per cent, the net profits amounting to more than $180,000. In Buenos Aires and in Entre-Rios, Argentina, the two newly organized affiliated concerns, while showing excellent prospects, have not been operating long enough to bring any great profit.

The Bolts Fork Telephone Co. of Boyd, Ky., has been incorporated with a capital of $2,000 by H. J. Ross, Clyde Bolt and Wilbur Rife, all of Rush, Ky.

The telephone plant at Wewoka, Okla., is to be replaced by one of larger and more modern design.

# Record in Restoring Service

*Wires and cables were strung over house-tops in "hurry-up" repair job at Philadelphia*

Philadelphia, Pa.—A remarkably interesting feature in the temporary reconstruction of the Pennsylvania Railroad Systems Broad Street Station train shed which recently was totally destroyed by fire was the rapid restoration of the telephone and telegraph circuits.

Some idea of the magnitude of the interrupted service may be gathered from the following list of cables, wire and apparatus that were destroyed.

1—102 pair, 1—78 pair, 1—75 pair, 1—30 pair, 1—33 pair paper and lead cables used by the Philadelphia Terminal Division for Telephone and Telegraph purposes.

1—53 conductor rubber insulated lead cable.

1—20 pair rubber insulated lead cable used for the telephone and telegraph system.

3—19 conductor rubber and braided signal cables.

1—7 conductor rubber and lead power cable.

2—1 conductor rubber and lead power cables.

1—24 conductor paper and lead telegraph cable used by the Postal Telegraph Company.

35,000 ft. Twisted pair wire used throughout train shed for fire alarm, telephones, call bells, clocks, telephone jack connections on station platforms, etc.

15 telephone sets, fire alarm switchboard batteries, etc., in the 16th Street Power House together with associated apparatus in the train shed including 12 electric clocks.

At 4:15 A. M. the morning of the fire, the General Superintendent of Telegraph and Signals called J. C. Maxon, railroad representative of the Western Electric Co. on the telephone at Maxon's home. By 7:15 the same morning the W. E. truck delivered the first load of No. 17 twisted pair amounting to 75,000 feet. By early afternoon W. E. delivered nearly 300,000 feet to the job together with 9,000 feet of 12 pair emergency cable. This material was put in use almost as fast as delivered and before noon the divisions connecting into the General Telegraph Office and the General Office Telephone Exchange were given service.

The Telegraph and Signal Department gave a remarkable performance of efficiency and speed in restoring service. Within 72 hours after the fire started they put up four hundred pairs of wires suspended from the house-tops on Filbert Street supported by two poles on the west side of 15th Street and carried through windows into the Terminal Room, Broad Street Station connecting the General Office telephone and telegraph cables.

## Oklahoma Has Big Telephone Development

Oklahoma City.—Robert C. Graham, advertising manager for the Southwestern Bell Telephone Co. in Oklahoma, states that from one exchange of 100 subscribers twenty-five years ago the company's business in Oklahoma has grown to more than 150 exchanges, serving 140,000 telephones. The company now has in Oklahoma more than 365,220 miles of wire connecting 250,000 telephones in Oklahoma through Bell and independent exchanges. The state has more than 72,000 miles of long distance lines. It has over 5,000 employes handling approximately 1,143,736 local and long distance calls daily. The company has 275,647 poles in Oklahoma, which placed end to end would reach 1,566 miles.

# Terminating Overhead Lines

## Foreign Correspondent Describes British Method of Attaching Lead Covered Wire to Aerial by Using Pot-Head Terminating Insulators—The New Parallel Twin Cable

By F. G. HYLAND

**Frank G. Hyland, of the Bengal Telephone Corporation, Ltd., of Calcutta, India, sends the following note to TELEPHONE ENGINEER. It may be of some interest to our readers as indicating how foreign practice in telephone wiring may be different in detail from that used in this country.**

The present practice of terminating overhead 2-wire telephone circuits applied by the British Post Office Engineering Department consists of running one-pair, lead-covered, leading-in cable direct to one of the pair of terminating insulators through one of two holes connecting a cavity in the top of the insulator with its outer shed.

The line wire is brought into the cavity through a hole connecting the cavity with the line wire groove of the insulator and is then joined to one wire of the leading-in cable. The other wire of the leading-in cable is extended to the second terminating insulator by a link formed by using a length of leading-in cable with its 2 wires bunched. This link enters the cavity of the leading-in insulator to which the leading-in cable is run by the second hole connecting the cavity with the shed and is joined in the cavity to the leading-in cable, and to the line wire in the other leading-in insulator. After the joints have been made, the cavities in both insulators are filled with jointing compound, care being taken that the spare hole in the cavity of the insulator which carries the link only is effectively plugged before the compound is applied. This method is shown in Fig. 1 a.

PRESENT METHOD OF CONNECTING TO LEADING IN CABLES

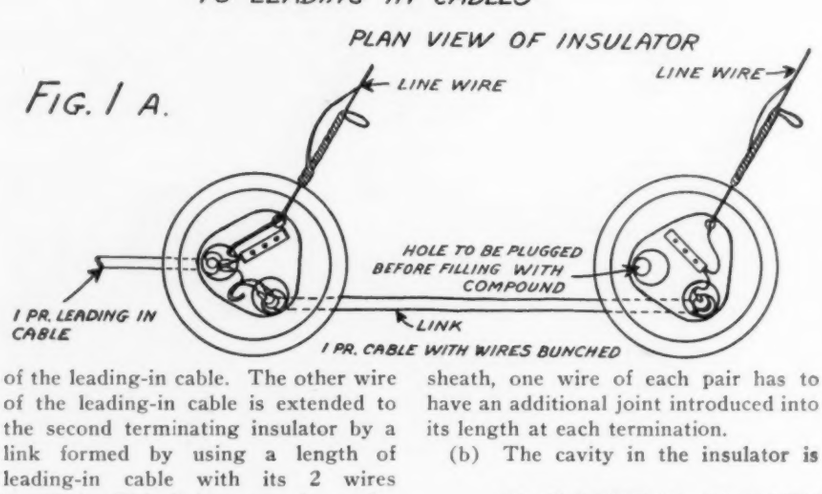

PLAN VIEW OF INSULATOR
LINE WIRE
LINE WIRE
HOLE TO BE PLUGGED BEFORE FILLING WITH COMPOUND
1 PR. LEADING IN CABLE
LINK
1 PR. CABLE WITH WIRES BUNCHED

FIG. 1 A.

In the writer's opinion this method of terminating contains several weak and undesirable features:

(a) By virtue of the necessity of havng to use a link in one wire of the pair at each point on the circuit where overhead wires are terminated to cover cables due to the fact that the two single wires forming the pair cannot be separated without loosing the mechanical protection afforded by the lead sheath, one wire of each pair has to have an additional joint introduced into its length at each termination.

(b) The cavity in the insulator is small and does not allow a very wide margin of safety for two joints in one cavity.

(c) One leading-in hole in one of the pairs of leading-in insulators has to be effectively plugged prior to compounding.

(d) The job when finished is unbalanced and on terminal poles and transposing poles the wiring is apt to become complicated.

These objections are partly overcome by using single, lead-covered wires; partly, because while overcoming the objections at the terminating insulators, the undesirable feature of running two parallel cables where one cable only would be used is introduced.

A parallel twin cable recently introduced by the British Insulated & Helsby Cable Co., Ltd., appears to offer an economical and efficient means of overcoming the objections raised and a description of the cable and suggested method of using it for overhead terminations is appended.

**Description of Parallel Twin Cable**

The Parallel Twin Cable consists of two 20-lbs. copper conductors, enameled, triple-cotton-covered and impregnated, laid up parallel in two circular lead sheaths. The sheaths are joined together by means of a continuous lead web formed with the sheaths. The

SUGGESTED METHOD OF CONNECTING TO LEADING IN CABLES

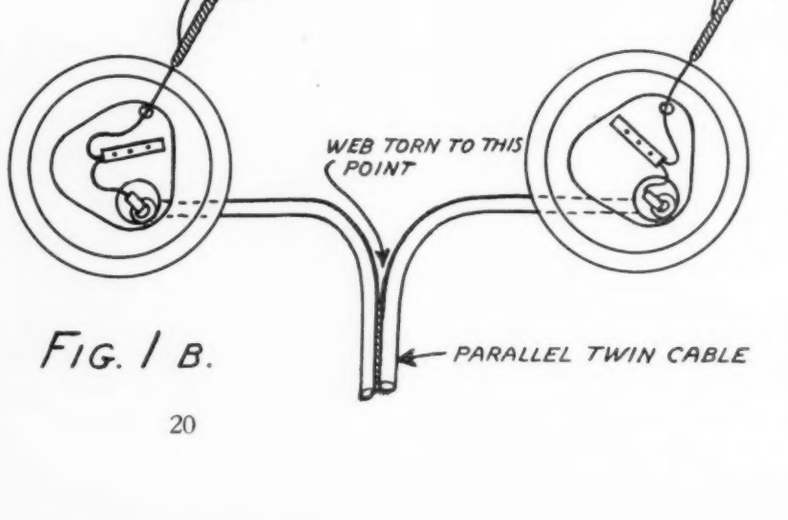



FIG. 1 B.

thickness of the web is considerably less than that of the circular sheaths, its cross section appearing O—O.

This cable can be supported by using the usual cleat, or by a pin with an enlarged head nailed through the web. This is the better and cheaper method, but care should be taken to insure that the pin is not driven in too far or it may injure the circular sheaths.

When using this cable at overhead terminations, the two circular sheaths are separated by cutting the web a little way, to the required length, with a knife as it then tears easily. The separate 1-wire cables thus formed are carried along the individual insulator fixings and terminated in the standard method in the insulator cavity. The method is shown in Fig. 1 B. It will, thus, be seen that for straight runs, this cable possesses all the advantages of a twin cable and can easily be split to form two 1-wire cables at the point where the individual mechanical protection for each of the two wires is required. Also, only one hole is necessary in the insulator cavity, and no spare holes have to be plugged before compounding.

*Parallel Twin Cable Suggested for Overhead Terminations*

Many tests have been carried out with a view to ascertaining whether the tearing of the web can possibly injure the sheaths, and it has been found that, owing to the reduced thickness of the web, the tear, no matter how carelessly made, cannot be induced to leave the web and enter the circular sheaths.

Owing to the girder formation of the lead sheathing, the cable is practically self supporting on horizontal runs and fewer fixings, consistent with neatness, are required as compared with circular section cables.

### *Resistance of 125 Miles in One Joint of Line, an Object Lesson*

Middlesburg, N. Y.—At the district meeting of the Up-State Telephone Assn. of New York held here the address of F. C. Follensby, general plant supt. of the Glen Telephone Co., Gloversville furnished the chief practical feature. In emphasizing the value and saving of proper construction methods, Mr. Follensby showed several joints that appeared to be well made, but, when tested, showed resistance equal to 125 miles of wire.

Discussions covering many phases of the business, and a successful operators' conference also made the meeting decidedly worth while.

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Wilkes-Barre, Pa.—The Susquehanna T. and T. Co. has been purchased by the Commonwealth Telephone Co.

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Barnsdall, Okla.—A new exchange building is to be erected by the Bigheart Telo. Co. S. H. Wilson is manager.

### *U. S. I. T. A. to Get Report on Substation Protection*

Chicago.—In a recent circular letter, the United States Independent Telephone Association advises member companies that arrangements have been made for Prof. R. V. Achatz, of Purdue University, to devote his time this summer to an investigation of the Telephone Sub-station Protection problem, and summit a report to the association at the convention the last week in October. Sub-station protection is of interest to all operating companies and manufacturers of equipment. The extension of high power electric lines through the rural districts has brought to telephone companies operating in those districts, the problem of protection against such high power currents for their rural sub-stations. The requirements of the Board of Underwriters and the inspection rules adopted by the various state departments having jurisdiction over such matters make it imperative that such an investigation and report be made at the earliest possible moment, so that the independent companies may have before them a definite statement as to conditions and requirements and the tendency of further regulations.

### *Radio Jobs Open*

The United States Civil Service Commission, Washington, D. C., announces the following open competitive examination: Radio Engineer, $4,000 to $5,000 a year; Associate Radio Engineer, $3,000 to $4,000 a year; Assistant Radio Engineer, $2,000 to $3,000 a year. Applications will be rated as received until October 30.

# Traer's Telephone Float

July 24 the Mutual Telephone Co., Traer, Ia., had a very interesting float in the parades celebrating the fiftieth anniversary of the founding of that city. The parade each day, which was about two miles in length, included several bands and hundreds of decorated cars and floats; also, a children's section and world-war veterans in uniform. About twenty thousand people attended.

The float of the telephone company represented a complete telephone exchange, including substations, outside lines and central office equipment. Four little girls kept the desk set telephones busy; the switchboard operator demonstrated the art of slinging plugs and the plant department was represented by a small boy rigged out as a regular lineman and holding a roll of wire.

The float was built on the telephone company's truck. The driver occupied a very inconspicuous position, only the top of his head protruding through the floor near the center of the float.

Several hundred scarlet paper roses, used for decorating this float, were made by the operators of the Gladbrook, Reinbeck and Traer exchanges.

### *Heroic Lineman's Feat*

Oklahoma City.—Charles Rider, of Guthrie, a lineman in the employ of the Southwestern Bell Telephone Co., distinguished himself recently in restoring telephone service across the Cimarron River north of Guthrie. In a Santa Fe wreck, gasoline cars in the train that went through a bridge exploded and the fire destroyed the Denison-Newton toll lead carrying seventeen circuits. Rider went six miles up stream, procured a boat and crossed the swollen and blazing stream close to one of the blazing cars, re-establishing communication with an interruption of less than six hours.

# Automatic Development

## A Brief Survey of the Present Development of Automatic Equipment—The Author Contends That Proper Engineering Can Make Automatic Feasible Even in the Smallest Exchanges

By F. J. Dommerque

The production of automatic telephone devices has progressed so far that it is safe to say automatic telephone operation will be dominating in the future. It is only a question of cost. As is well known, an automatic telephone system is a trunking system throughout, the different switches constituting an automatic exchange being connected by trunk lines over which all calls must go regardless whether they are local or trunk calls. The circumstance that at the present time hardly any small telephone plants are operated automatically has its reason in higher cost of equipment for such small exchanges over manually operated switchboards.

Manual switchboards increase in their cost not in a straight ratio to the number of subscribers, but in a ratio more nearly quadratic—although this may be putting it on too thick, but it is somewhere between the two—while the cost of automatic switchboard equipment increases practically in a straight ratio. The consequence is that it pays to operate large exchanges automatically. Therefore, we see taking place in the large cities in this country and more so in Europe, a conversion to automatic operation. Some years ago the line where the annual expenses for automatic and manual operation were equal was at about 3,000 subscribers, today it must be far below that. Exactly where it is does not matter, as with proper engineering there is no reason why not every proposition, large or small, should not lend itself to be remunerative when worked automatically. One must only know how to do it.

The automatic systems on the market are few, that is, systems that are workable and efficient. The oldest one and the one which has found the greatest number of followers is the so-called Strowger System, consisting of switches working step-by-step. The armature of an electro-magnet is provided with a pawl which, by means of teeth cut around the shaft, either lifts or turns a shaft carrying a contact arm, one step for each current impulse sent through the magnet. The Strowger System appears to be the most feasible one, as it can be adapted to small as well as large size exchanges. The switches are arranged on the decimal basis, consisting of ten levels of ten contacts each. One must keep in mind that Strowger Systems and Strowger switches are not the same everywhere. In this country, when speaking of a Strowger System, one has usually reference to the system built by the Automatic Electric Co., but in other countries systems have been developed which use the Strowger ideas as a basis, but deviate materially from the design and circuits adopted in this country. One sees many improvements on the other side of the Atlantic that are well worth acknowledgment.

As the trunking is the most important feature in the arrangement of an automatic system, and as the satisfactory operation of the plant depends pre-eminently upon this trunk arrangement, it is apparent that a universal switch like the Strowger switch may not serve all sizes of exchanges equally well. In systems where the trunk groups are small the arrangement of ten contacts for each level may be too large, as ten trunks may not be required in the group. On the other hand, traffic may require more than ten trunks in the group to operate efficiently and economically.

The number of ten-contact sets or ten trunks per group probably originated in making the bank of a switch equal to the bank of 100 jacks in a manually operated switchboard where the jacks were arranged in ten strips. In automatic operation the groups are determined by the number of simultaneous connections. For the Strowger System it has been taken that for 100 subscribers 10 is the maximum of simultaneous connections, which has been shown to be correct by innumerable observations, but the same observations have also shown that if there are a larger number of subscribers, and consequently a greater number of simultaneous calls, the number of simultaneous existing connections becomes less in proportion.

In general it may be stated that observations have shown that with 10,000 subscribers in a group the highest number of simultaneously existing connections in the group is 450; with a 2,000 subscriber group, 100; with a 1,000 subscriber group, 54; with a 500 subscriber group, 31; with a 200 subscriber group, 16, and with a 100 subscriber group, 10. If Strowger type switches are employed, which have 100 contact sets, that is, work with 100-groups, 10 connector switches will carry the traffic of a group. If, however, switches with 200 contact sets, affording 200-groups, are used, only 16 connector switches per group will be required, and if switches can be made to have 500 contact sets, that is 500-groups, 31 connector switches would be necessary to provide facilities for all connections which occur at the same time, in the group. Therefore, with larger switches and, what means the same, larger trunk groups, fewer switches are required; but, as is natural, larger switches are more costly to build and therefore it is questionable whether it would pay to introduce switches with a larger number of contact sets than there are in the Strowger type switches. However, there may be reasons other than financial for doing so; if the service demands it, such higher expense may be justified, and that most likely was the reason which induced the Western Electric Company to construct switches with 200 and 500 contact sets, to be used in such cases where the large number of subscribers provided sufficient traffic to form large trunk groups, and for extreme cases where 100-groups would render the system too cumbersome and too complicated, as for instance in New York and Chicago.

The 200-line switches of the W. E. Co. are not used in this country but are found in many European cities. They are power driven from a continuously-running motor shaft. If a call is made a magnetic clutch couples the switch shaft to the motor-driven shaft and the switch shaft rotates the contact brushes until proper connection is made, when it stops again. This is a rotary type switch. The 500-line switches of the W. E. Co. are of the panel type, where all 500 contact sets are arranged upon a vertical flat panel. For every connection the contact brushes are lifted up to the proper contact set. It is not intended here to go into any description or further discussion of these large switching systems, but it may be mentioned that a number of competent European telephone engineers have asserted and corroborated by figures

that the same efficiency in operation as is obtained by such large switches can be obtained by Strowger type switches by properly grading and shifting the multiple, by the use of primary and secondary line switches and other combinations.

Successful attempts have also been made to construct special automatic switchboards for the use in small exchanges. There we have in the first instance the socalled "Relay system." In such systems a number of relays of the usual type are so arranged that a relay connects the calling line to an idle trunk line thence to a group of relays which continues connection until the desired line is reached. Fig. 1 may illustrate the fundamental idea. One, 2, 3, 4, 5 are subscribers' lines; a, b, c are trunk lines; R are relays or rather relay windings, one end of which is connected to the subscriber's line and the other end to the trunk line. A relay is placed at each crossing of a subscriber's line with a trunk line. When a subscriber calls, a relay connected between his line and an idle trunk line will operate and connect him through. There is a whole chain of relays involved in a connection and with an increasing number of subscribers the number of relays required increases rapidly. Relay systems have proved practical up to 100 or 150 subscribers. Expanding the system to a larger number of subscribers is being attempted, but its practicability has yet to be demonstrated. The difficulty lies in too small trunk groups and too great a number of relays.

The producers of Strowger type switches have also taken interest in the production of an automatic system suitable for small exchanges. It appears that in Europe better progress has been made in this direction than in this country. This may have its reason in the different requirements in telephone service for small exchanges here and over there, and also in the government control or other ownership of the telephone business which turns out to be of economical advantage in this case. This will be easily understood when one considers that the automatic apparatus can be located in the post office in a place which would not increase the rent any or very little. The postmaster can keep a stock of reserve switches or reserve parts from which he can replace any switch becoming defective. To this end the switch and wire connections have been made of the bayonet type, so as to make soldering unnecessary. The mail carrier on his route can keep an eye on the pole line and report any defects he observes. The telegraph is also owned by the government and in case of a breakdown the postmaster has the telegraph at his disposal to call for assistance. There are many other minor advantages.

Then there are no farmer lines in Europe (at least not in Continental Europe, England may have some, but the writer has never heard of any anywhere on his travels through European countries). There is no occasion for farmer lines as the farmers own only a few acres of land each, which they cultivate intensively and which does not give them room to build on. The farmers all live in villages for

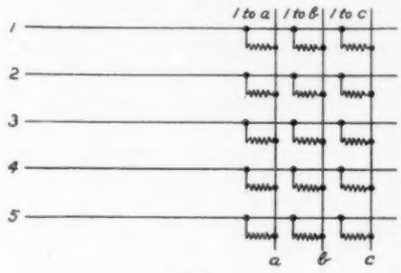



*Fig. 1*

several reasons: first, it seems to have been necessary to live together for protection in the middle ages where robber-barons frequently ransacked the country; second, in modern times each individual farmer had too little ground and too small a pocket-book to buy agricultural machinery and therefore they owned such machinery collectively on the co-operative plan, which was facilitated by living closely together. Therefore a country village was naturally adopted for a small automatic exchange. Of course there are also large estates in Europe, owned by the old nobility or rich land magnates, but they want individual telephone lines. Furthermore, Europeans are adverse to party lines. Consequently one rarely finds anything but direct line service, which also favors matic operation favors decentralization, right here that many engineers, including the writer, consider party lines only a makeshift to afford people with limited means the opportunity to have a telephone; the engineers see in automatic service an opportunity to eliminate party lines entirely, because automatic operation favor decentralization, it lends itself to a division of the plant into main offices, branch offices and sub-offices to such an extent that an enormous saving in the wire plant, which always is the costliest part, can be achieved, weeding out the doubtful advantages of party lines.

While in this country such obstacles as farmer lines and party lines were in the way and the magneto board gave excellent and economical service, the small automatic board was not exploited as it deserved. In continental Europe the subject found better appreciation. Manufacturers of telephone apparatus as well as government engineers saw the possibilities and set about to design systems especially adapted for small exchanges. They first of all simplified the apparatus, then they developed circuits free from complications of wiring, etc., and finally they adapted the system to the use of a 24-volt battery instead of 46 to 60 volts as was the case with the older systems.

The operating engineers studied each individual case so as to transfer all the economies obtained in larger systems to the rural system by co-ordinating and subordinating a number of villages with or to the country town as a center, from which toll and long distance lines radiated. In short, all factors worked in the direction of producing an automatic equipment and giving it its proper environment so as to give the small automatic exchange the same prestige over the manually operated plant as was already the case with large automatic exchanges.

In this monograph the writer has endeavored to give briefly a general review of the present state of automatic telephone activities and to lay particular emphasis upon the fact that there is no longer anything in the way of operating small propositions economically with automatic equipment.

## *More Telephones in Holland*

Rotterdam, Holland.—Developments indicate the adoption of a complete automatic system in all the principal cities of Holland in the near future. The telephone systems in the larger cities of the country, and in fact, in all cities and towns, with the exception of one or two small places, are either owned and operated by the national government, as a supplement to its mail and telegraph services, or by the municipalities themselves under concession from the national government. In all cases, the interurban and long distance services, extending beyond the borders of the country, are operated by the Federal Government.

## *"Radio" for Japanese Fishing Boats*

Nagasaki, Japan.—The chief of the Nagasaki Perfectural Marine Products Bureau, together with a committee of men interested in marine products, is reported to be investigating the possibilities of installing wireless telephone outfits in the larger sized fishing boats which have their base at Nagasaki, to enable them to communicate with shore when in difficulties, and to report the catch.

# Everyday Telephone Helps

## Fourth of a Series of Articles for Beginners; for Students, Small Plant Managers, Rural Line Owners and Others—Fundamental Facts, Principles and Practices—About Batteries; Handling and Testing Dry Cells

By P. Kerr Higgins

*Since printing the July issue of TELEPHONE ENGINEER, we learn that Mr. Higgins' last article covered, among other things, a system which Harry N. Faris, of the Kellogg Switchboard & Supply Co. at Kansas City, Mo., has induced many of his telephone clients to adopt. Our readers, therefore, will appreciate its practical character all the more.*—Editor.

The previous article was devoted entirely to batteries but there are still a number of important points to be covered. The writer has purposely avoided making any quotations from Circular No. 79 of the Bureau of Standards, Washington, D. C., second edition, published January, 1923, as copies can be had from the Superintendent of Documents, Government Printing Office, for fifteen cents per copy. This pamphlet is highly recommended to the telephone student.

The question has been raised as to when a dry battery should be thrown away. If one cell in a set is bad, it will affect the whole set. It is convenient to use a pocekt gauge in testing cells of battery. The pocket gauge first should be tried on a cell which is known to be good. In this way the proper deflection will be known. Some telephone men use an electric door bell for testing, in which case the good cell will ring the door bell while the bad one will not affect it at all. Dry batteries which show good results when tested at a normal temperature on a testing ammeter will not show a full reading when cold.

**Handling and Testing Dry Cells**

The greatest possible care should be taken in handling dry batteries. They should be trucked and never rolled or turned from end to end when moving them. They should be unpacked promptly and placed on end on shelves in a dry place. Remember that batteries deteriorate on the shelf as well as in use. Before putting any cells in use they should be tested with a reliable pocket ammeter or other current indicating device to make sure that each cell has a full rating. Reject all cells having damp or moist pasteboard covers or put on new coverings after wiping the zinc dry. If an ammeter is used, each No. 6 dry cell should show a discharge of at least fifteen amperes when the ammeter connections are made direct to the cell terminals, and should not fall below this amount when the discharge is maintained for about five seconds. Used batteries should be discarded when the reading thus taken falls below two amperes. Be sure not to make these tests too often and in no case for a longer period than five seconds, as it a severe drain on the cell.

If a volt meter is used for testing, a dry cell should be discharged continuously through a resistance. The general practice of making an open circuit reading across the cell terminals, but without any apparent discharge, gives no indication whatever of the condition of the battery. This can be proved by testing a worn out battery which will often show full voltage reading on a high resistance volt meter. However, this same battery will give practically no current and if connected in series with other batteries will destroy the efficiency of the whole series. Another test some times used is made by connecting a twelve-inch piece of No. 30 B. & S. gauge copper wire across a new cell in which case it will heat up so as to be almost too hot to hold. If the current discharge keeps up the same heat after the wire has been held against the terminals for five seconds, the battery may be considered good. However, this test is recommended only in case of an emergency and not for regular use. Dry cells showing wet spots on the jacket should be discarded, especially when working in series with others.

All connections between cells should be of No. 18 Brown & Sharp gauge copper wire and the ends cleaned or scraped bright and held in place by spring connections. In scraping wire, care should be taken not to nick the wire as this will cause a break at some future time and cause trouble. Protruding wire ends should be clipped off so as to avoid short circuits in connecting wires. Also be on the lookout for short circuits between battery terminals. All cells showing a low rating should be separated and (if used at all) be used at stations close to the central office, thus reducing replacement costs. Oftentimes cells which have been recovered from sub-stations and reading 1.1 volts would still be found useful on the pole changer battery, while less than .8 volt should be completely discarded.

The amperage of a dry cell is raised about one ampere for each ten degrees centigrade rise in temperature. This value varies considerably with different types of cell and is somewhat greater at low temperature than high. It is a well known fact that there is an increase of chemical action in a dry cell at high temperature and a decrease at low temperature. On the shelf therefore a cell will deteriorate slowly at a low temperature and this deterioration will increase if the temperature is increased. Cells thus stored in a dry atmosphere where the temperature is kept below the freezing point of water will show no appreciable deterioration, whereas those stored in an atmosphere of 100° F. or above will show the effect of harmful action in a comparatively short time; therefore, store dry cells in COOL places.

In groups of cells the greater the degree of uniformity the more satisfactory will be the results. It is a great mistake to order large quantities of cells at a time as experience shows that fresh cells are always much more efficient for sub-station work. Hence the number of cells kept in stock should be as small as possible. When shown in circuit drawings, the zinc or negative electrode is represented by a short, thick, vertical line and the copper or positive electrode with a thin vertical line about twice the length, the two forming what is known as a couple or cell. The question has often been asked, can dry cells be renewed? The answer is, yes, but the writer has never had much success in doing so.

**Some Facts About Current Flow**

Some years ago there was published by one of the largest manufacturers of dry batteries a small pamphlet entitled "Analogies between Battery Current and Water Flow." It is understood that these are now out of print. However if they can be obtained the pamphlet will prove to be very good reading. As the writer remembers, the

following are some of the thoughts brought out: Dry batteries are not suitable for large amounts of power; however, they contain the maximum amount of power for the minimum amount of weight, and the flow when the proper amount of current is used is even and powerful. A leaky outlet in a water pipe means wasted power, drop in pressure and inconvenience. Hence a poor connection in your battery means increased resistance and a loss of current and voltage. A faulty connection may cause intermittent trouble or a broken circuit. The unit of quantity in electricity is known as the coulomb, the equivalent in water being the gallon and these are independent of all other units. The current of electricity is expressed as coulombs per second. The ampere represents a current of one coulomb per second. In the case of water, the unit is so many gallons per second.

In a water supply the pipe offers resistance to the passage of the water. In like manner any conductor used for the transmission of electricity offers resistance to the passage of the current. So far the hydraulic unit has not been named. However, the electrical unit is known as the ohm. Electrical resistance depends upon three things, the nature of the material of which the conductor is composed, the length of the conductor, and its cross sectional area. In the case of water a rough pipe will present more resistance to the flow than will a smooth one, say of polished steel. A conductor of carbon will have a much higher resistance than one of the same size of copper. Again a short pipe will offer less resistance than a long one of the same area. In a similar manner a long wire will have more resistance than a short one. It is easier to pump water through a large pipe than through a small one and the same is true of forcing current through wire. Resistance then is a property of the conductor and hence independent of the current.

Pressure necessary to cause the flow of water in a pipe is represented in electricity by voltage which is frequently called electro motive force. (E. M. F.). The unit of electrical pressure is known as the volt or the electro motive force necessary to cause one coulomb per second (one ampere) to pass through a resistance of one ohm. Two tanks of water may be of different capacities, but if the head of water is the same in each, then the pressure at the stop cock will be the same in both tanks regardless of the different capacities. Similarly two dry cells may have the same voltage even though they are of different size. However, the difference in size means that they contain different amounts of electricity. The voltage of a dry cell does not depend on its size, and the average is about one and a half volts.

Power is the rate of doing work or the accomplishment of a definite mechanical act, such as lifting a pound weight two feet, which would represent two foot pounds of work. The unit of mechanical power is foot pounds per second. Power increases with flow when considered in connection with water. Likewise power increases with current when considered in connection with electricity. Again if two tanks are used having equal flows at different pressures, the same number of gallons of water will be discharged per second from each, but the high pressure tank will lift the water higher than the low pressure tank.

BATTERY OF 5 DRY CELLS CONNECTED IN SERIES.

Voltage about 7½. Amperage about 20.

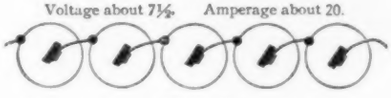


*Fig. 1*

Hence the first jet has more power, because it raises the same amount of water to a greater height in the same period of time. It is thus seen that power increases with pressure as well as flow. The same is true in electrical work where electrical power increases with voltage as well as with current. It is therefore proportional to the product of the two. A watt is the power in a circuit having one ampere flowing under a pressure of one volt, the rule being as follows: Watts = electro motive force multiplied by current.

The same apparent capacity does not always indicate the same amount of service obtainable either in the case of water or batteries. Service in connection with batteries is usually understood to be the length of time a cell or battery will continue to operate a given apparatus until the voltage falls to a definite value. In water the lighter the flow the longer the service. In dry cells the lower current drain the greater becomes the capacity of the cell. Service is thus increased when energy is drawn slowly. If the current drain is reduced to one-half, the length of life of the cell will be more than double. This in some measure explains the increase in service obtained by connecting several cells in parallel, which has the effect of dividing the current drain equally between the cells. Service may also be increased by allowing them to have certain periods of rest for recuperation. What is known as initial current is the current obtained by short circuiting a cell through an ammeter. The resistance of the external circuit to the ammeter is very low and the principal resistance is that of the cell itself. Hence the drain in any kind of work is less than the lowest initial current and a low current cell may give just as good or better service than a very high current cell.

### Effect of Connections on Voltage and Current

Batteries may be connected up in one of two methods, namely, series or parallel (multiple) or a combination of these. When a battery is connected in series this means that the copper (or carbon) of one cell is connected with the zinc of the next cell, as shown in Fig. 1. When a battery is connected in parallel (or multiple) the carbons (or copper) and the zincs are joined together. It may be well at this time to consider how these various arrangements affect the current output. In the series method where each carbon or copper is joined to its adjacent zinc the electro motive force (voltage) of one cell is added to that of the next, hence the total voltage would be that of all the cells thus connected added together. Likewise, since each cell offers a definite amount of resistance to the current, the total internal resistance of the group or set would be the sum of the separate cell resistances. Take for example three cells, each having a resistance of two ohms and an E. M. F. of one volt. If this battery be now placed on short circuit, then practically the only resistance in the circuit is the internal resistance of the battery, the resistance of the connecting wire being so small as to be negligible. To find the current output of such a battery we would use the following formula:

$$\frac{EMF}{R} \text{ equals C or } \frac{3}{12} \text{ equals .25 ampere.}$$

If the number of cells is doubled there will be no increase of current for the internal resistance will also be doubled. Hence, you might have a very large number of cells thus connected and the current output would still be the same as from one cell so long as there is no appreciable external resistance.

If we had two groups of three cells each, each group being connected in

series and the two groups connected in parallel, the result would be as follows: As each cell has two ohms resistance each group would have a resistance of six ohms, but since the two sets are connected in parallel, the joint resistance would be cut to one-half of one set or a total of three ohms, hence the E. M. F. is three volts, the circuit resistance three ohms, and the current by the same rule (Ohms Law) would be one ampere. You will notice that in this arrangement of cells, the E. M. F. is one-half of the E. M. F. in series, but the resistance is only one-fourth, hence the current strength is doubled. Let us now make up a set of six cells and divide it into three groups of two cells each. When the three groups are connected in parallel, there are only two cells in each set and hence the E. M. F. is only two volts. The resistance in each set is four ohms and the total (or joint) resistance equals one and one-third ohms. The current therefore by the same law is two divided by one and one-third equals one and one-half ampere.

In this case the E. M. F. is one-third of the E. M. F. in series, but the resistance is only one-ninth. The current is therefore three times greater. Now let us take a case having an exterior resistance of say twelve ohms and see what happens.

In series the current is $\frac{6}{12+12} = .25$ amp.

In two parallel sets, $\frac{3}{3+12} = .2$ amp.

In three parallel sets, $\frac{2}{1\frac{1}{5}+12} = .15$ amp.

Where there is considerable resistance in the external current the greatest current is secured from series connections, as will be seen by using an external resistance of say sixty ohms, which would give us the following result:

In series $\frac{6}{12+60} = .083$ amp.
In two parallel sets, .047 amp.
In three parallel sets, .032 amp.

It is apparent, therefore, that increasing the E. M. F. will increase the current in about the same proportion for although each cell in series adds resistance, the whole resistance of the battery is small compared with the resistance of the external circuit. If we therefore desire to increase current on a long telephone lines, the number of cells in series would have to be increased. On the other hand, if the battery resistance is important, better results are obtained by using the sets of sets in parallel, thus reducing the battery resistance. In other words, the best arrangement of cells and battery is one which brings the resistance of the battery as nearly as possible to that of the circuit of which it is a part, thus securing the greatest current strength. The following is an illustration:

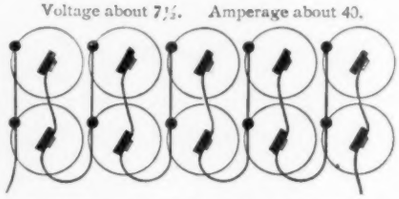
Assuming an external resistance of say four ohms, how can we secure the largest current from eight cells?

In series the internal resistance equals sixteen ohms.

In two parallel sets of four cells each resistance equals four ohms.

BATTERY OF 10 DRY CELLS CONNECTED IN COMPOUND SERIES-MULTIPLE.

Voltage about 7½. Amperage about 40.



BATTERY OF 10 DRY CELLS CONNECTED IN MULTIPLE-SERIES.

Voltage about 7½. Amperage about 40.

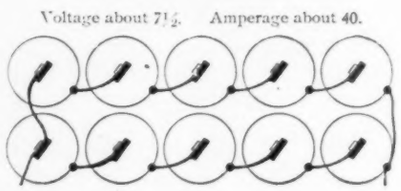


*Fig. 2*

In four parallel sets of two cells each resistance equals one ohm.

Hence the second arrangement will give the largest output, namely, .5 ampere.

It is immaterial whether wet or dry cells have been used in these examples as there is practically no difference in the current excepting the output. A new dry cell has about 1.5 volts and on a short circuit will give from ten to fifteen amperes according to the area of the zinc and the size of the cells. A wet cell has from 1.3 to 1.5 volts and from 7 to 20 amperes on short circuit, varying according to the size of the zinc used.

Fig. 3 shows two different combinations of series—parallel connection of any cells. It is suggested that the reader verify the voltage and short-circuit current values given. The results of the discussion above may be summarized as follows:

A single cell gives $C = \frac{E}{r\ R}$ where

C=Current, E=Voltage, r = Internal resistance of cell and

R=External resistance. When several cells are connected in series,

$C = \frac{N\ E}{Nr+R}$ where N = number of cells. If the internal resistance of the battery is small compared with the external resistance it may be neglected.

The general rule may be stated: when cells are connected in series, the voltage of the group is the sum of the voltages of the individual cells; when connected in parallel, the current output is the sum of the current outputs of the individual cells.

The formula: $C = \frac{E}{R}$ which has been used in the foregoing sections is known as Ohm's law and is familiar to most telephone men.

This has been changed in recent years so that it is now represented in the following manner: $I = \frac{E}{R}$. In the former C represents current. In the latter I represents current. E is an abbreviation for electromotive force and R an abbreviation for resistance and is read "Current is equal to the Electromotive Force divided by the Resistance."

Example: Let the value of E equal 75; let the value of R equal 150, then performing the operation indicated

$\frac{(E)\ 75}{(R)\ 150}$ equals I = .5

Hence .5 is the value of the current flowing in a circuit having 150 ohms resistance and a voltage of 150 volts.

To obtain the E. M. F. (or E) the following formula is used: I x R =E and hence the voltage is equal to the resistance multiplied by the current. Using the same values as in the former example we have

I x R = .5 x 150 — 75 which is the value of the E. M. F.

Electrical power which is expressed in watts is equal to the product of the square of the current expressed in amperes multiplied by the resistance in ohms, or W equals $I^2R$.

Again this may be expressed in horsepower by dividing the watts by 746 which is the number of watts in one horsepower.

**Ohm's Law an Important Relation**

Ohm's Law is the cornerstone of the science of electrical measurement. It usually presents itself in a familiar form so well expressed by the statement that "The current is proportional to the electromotive force and inversely proportional to the resistance."

From this it may be seen, that if we have equal voltages applied to two circuits, the currents will be inversely proportional to the resistances of the circuits. That is, a high resistance allows only a low current to flow. This law also states that in circuits of equal resistances, the current is directly proportional to the voltage applied. It is apparent then that both these conditions show the current to depend on the voltage and resistance. This is very important. The current

varies directly with the voltage and inversely with the resistance, and it is evident that if we increase voltage and resistance proportionately we may keep the current the same.

It is extremely important that the telephone man thoroughly familiarize himself with Ohm's law in its several forms as without an intimate knowledge of it, he will be unable to appreciate or understand the many problems which present themselves from day to day. Many illustrations of its operation could be given, but we will content ourselves at this time with what has already been said and amplify, and illustrate its operation in more detail later when considering electrical measurements. This law, be it noted, is only absolutely correct in the case of a continuous current, but is not precisely accurate when applied to an instantaneous or an alternating current and a modification must be used when applied to such currents. This application is rather complicated and will be discussed later.

**QUESTIONS WILL BE ANSWERED**

**The Author has had many queries in regard to preceding articles, and these will be fully answered before the close of the Series on Sub-Station Equipment.**

**The Author also writes to express the many compliments received and will endeavor to merit same in coming articles.**

**P. K. HIGGINS.**

### *Central Texas Meet at Waco Practical Affair*

Waco, Tex.—A conservative estimate forecasts the telephone census of the U. S. as 25,000,000 in 1940, according to J. C. Paxton, who spoke on the "Future of the Telephone" at the Central Texas meeting of the Texas Independent Telephone Assn. Among other addresses made at the meeting were those by Sam H. Shutt on "Increasing Toll Revenue," George McQuaid on "Getting the Facts of Your Business to the Public," and by D. H. Walter on exchange management.

The Texas financing plan was detailed by R. B. Still, president of the organization. "Proper Methods of Plant Maintenance" were described by R. W. Garner. Another interesting technical paper was that on proper care of storage batteries which was read by C. D. Kinne. "The Necessity for Proper Accounting Records" was the subject of the paper presented by L. E. Ponder. J. W. Davis, vice president and sales manager of the Meadows Grocery Co., of Waco spoke on "Telephone Service in Present-Day Business."

The attendance at the meeting included representatives of practically every company in central Texas.

### *Western Pennsylvania Holds Merry Meeting*

Conneaut Lake Park, Pa.—An address by J. K. Johnston of Indianapolis on "Plant Appraisals," and one by H. M. Engh of the American Appraisal Co. on "Unit Costs" featured the managers' session of the second annual summer convention held by the western division of the Pennsylvania State Telephone and Traffic Assn. held here July 25-27.

An operators' conference was held during the meeting. A number of papers were presented, covering many phases of traffic.

For the first time the telephone industry took an official interest in one of the country's most important problems, bootlegging. In a manner befitting a summer meeting, the bootlegging business was given thorough consideration from theoretical and practical viewpoints. A new organization, known as the Amalgamated Order of Bootleggers was formed, and elected John Wright of Jamestown, N. Y., director-general. The burlesque of organization and convention activities proved to be the best laughgetter that has been introduced in telephone convention circles for many moons.

The Meadville Telephone Co. was host at a convention dinner, which closed with the bootlegging business discussion.

### *District Conventions Boost Phone Harmony*

Oklahoma City.—The second annual conventoins of the First and Second Districts of the Telephone Division of the Oklahoma Utilities Association were held at Broken Arrow and Quinton, Oklahoma, on July 19 and 21 respectively. These districts comprise sixteen northeastern counties of Oklahoma, and about one hundred telephone company executives and representatives attended these conventions. Practical problems and public relations were the chief subjects.

The 1924 convention of the First District will be held at Wynona in Osage County under the direction of E. H. McHenry of Wagoner, and Mrs. C. O. White of Wynona, who were elected chairman and secretary respectively of the First District at the Broken Arrow meeting. The Second District convention of 1924 will be at Heavener in LeFlore County. A. W. Cook of McAlester was elected chairman, and Miss Eddie McBryar of Heavener secretary of the Second District at the meeting at Quinton.

J. W. Walton, chairman of the Telephone Division of the Oklahoma Utilities Association, announces further district conventions for this year as follows: September 6 District No. 3 at Durant, September 11 District No. 4 at Oklahoma, September 18 District No. 7 at Carnegie, September 20 District No. 6 at Frederick, October 2 District No. 5 at Kingfisher, October 4 District No. 8 at Woodward.

# *Vermont State Meets*

Burlington, Vt.—Public service corporations today need as much protection from the public as the public does from the utilities, declared W. A. Dutton, chairman of the Public Service Commission of Vermont, before the third annual convention of the Telephone Association of Vermont. In his address, which was one of the features of a well attended, practical meeting, Judge Dutton also paid his respects to the "fixer" who adjusts the differences between the utility and its patron. The telephone business is a natural monopoly in its community, Judge Dutton remarked, but the natural selfishness of the human makes monopoly dangerous.

J. G. Ihmsen of the Up-State Telephone Association of New York, also addressed the convention, emphasizing the need for a 100% exchange operating condition so there could be effective co-operation of all companies in uniting the entire country in an efficient telephone system.

Standardization was the subject of the talks made by F. W. Story and F. W. Davis of the New England T. and T. Co., Boston. A first aid demonstration was conducted under the direction of Dr. E. W. Bullock of Boston.

The managers' and plant conference, in charge of C. J. Knickerbocker of the Granville Telephone Co. made a feature of plant accounting and depreciation. The subject was introduced by F. E. Waring of the New England T. and T. Co. An operators' conference was conducted by Lillian A. Vavasour.

Re-election of the officers and directors keeps the official roster as follows:

C. D. Cushing, Bethel, president; C. L. Spear, West Corinth, vice-president; C. L. Ovitt, Enosburg Falls, secretary-treasurer; and F. H. Cheshmore, Jonesville, auditor.

Directors elected were: C. D. Cushing, Bethel; F. H. Cheshmore, Jonesville; A. W. Foote, Middlebury; C. L. Spear, West Corinth; F. W. Story, Boston, Mass; M. W. Hicks, Granville, N. Y., and C. L. Ovitt, Enosburg Falls.

# Practical Plant Problems

## Chapter XVI—Buried Cable, Its Use and Abuse

By Charles W. McKay, Associate Editor*

About ten years ago Mr. C. Y. McVey—formerly President of the Ohio State (Independent) Telephone Co. and now a director of the Ohio Bell Telephone Co.—asked the writer when, in his opinion, buried cable could be used without jeopardizing the safety of telephonic communication. In his reply, the writer suggested that one of the prime factors to be taken into consideration was that of soil condition—and the possible reaction of a given soil upon the sheath encompassing a telephone cable.

In the course of this conversation Mr. McVey stated that he was contemplating the installation of short sections of buried cable in or near Cleveland, Ohio. The writer suggested that Mr. McVey obtain samples of the soil at each location, where he proposed the installation of a buried cable system, and send these samples to the State University—or to some other reliable testing laboratory—together with a sample of the cable sheath, requesting an analysis of the soil and a determination of the possible chemical reaction of the soil upon the cable sheath.

All things considered, the writer believes that a program similar to the foregoing is most important in all cases where telephone companies are considering the installation of "buried cable." By "buried cable," of course, we mean cable that is buried directly in the ground without the protection that is afforded by the usual type of underground conduit construction.

It is a fact—and one that has been demonstrated with most disastrous results in the case of many telephone companies—that certain soils contain minerals (or chemicals) which tend to deteriorate the sheaths of telephone cables. The writer happens to know of a case in New York City where the telephone company incurred an appreciable expenditure for the installation of a rather complicated interior block underground cable system. Within a comparatively short time after its installation, "trouble" developed in this system. To clear the trouble it was necessary to make frequent excavations. As most of the cable had been buried under the lawns of high-class residential property—quite naturally, many complaints resulted. The company, therefore, was not only put to the expense of locating and clearing the trouble, but it was put to the additional expense, and inconvenience, of settling the claims of property owners. Eventually it became necessary to abandon nearly all of these cables and to substitute the interior block pole method of distribution—which method we have already considered in some detail. If the company had had the foresight to adopt the plan previously suggested—that of analyzing the soil before the cable was installed—considerable inconvenience and much unnecessary expense would have been eliminated.

In connection with the buried cable problem, there are many other factors to be considered. The proximity of electric light, power, or trolley systems must be taken into account. In connection with the electric problem, however, it may be said that—unless the conditions are too bad—ways and means may be devised of properly protecting the cable, through bonding, etc.

Another most important factor to be considered is that resultant from the general problem of plant engineering—the problem we have been considering throughout this entire series of articles. Quite obviously, the buried cable system of distribution is not flexible. It is not possible to "pull out" one cable when it becomes congested and replace it with a larger one. If the cable is replaced—or if additional facilities are provided—an appreciable expenditure is involved.

In connection with our previous consideration of the general problem of plant engineering, attention has been directed specifically to the need for a careful engineering survey; the provision of facilities to take care of immediate requirements and the provision of facilities to care for future requirements. Obviously, if the "fundamental plan" shows that only twenty-five pairs are required now—but that one hundred pairs will be required within the "five-year-period"—the installation of a buried cable would be a questionable investment. A twenty-five pair cable would be too small to fulfill the ultimate requirements and the annual charges accruing against a one hundred pair cable (with seventy-five, or more, pairs lying idle for some time) would be prohibitive.

Especially in connection with the plants of the smaller telephone companies, many conditions arise where the buried cable "just fills the bill"—assuming that the soil problem has been properly analyzed and all of the other factors, hereinbefore discussed, have been given due consideration. Take, for instance, the case of a heavily loaded open wire lead where tree conditions are unusually bad—or where the winter storm problem merits serious consideration. In such cases it frequently happens that the installation of a buried cable will solve the problem satisfactorily—both from an economic and a maintenance standpoint.

There may be many other cases, in connection with the smaller telephone properties, where the buried cable mode of distribution will prove satisfactory from an economic standpoint and will be equally desirable when viewed from the angle of successful operation and satisfactory maintenance.

In conclusion, may the writer suggest that every problem involving the installation of buried cable should be subjected to a thorough analysis—from the standpoint of soil conditions; from the standpoint of electrical hazards and finally, but no means least, from the standpoint of the plant engineering requirements as developed through the medium of the "development study" and "fundamental plan." If you find yourself confronted with a perplexing problem of this nature, the writer, as Associate Editor of TELEPHONE ENGINEER, will be only too glad to co-operate with you, if you will send him full and complete details as to all pertinent facts.

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The Mountain States Telephone & Telegraph Co. will spend over $63,000 on improving its plant at Missoula, Mont.

*Mr. McKay is manager of the Valuation Division of The Roberts-Pettijohn-Wood Corporation, 646 North Michigan Avenue, Chicago, and consultant on telephone engineering problems.*

# Valuation in Rate Making

## Chapter XVII—Collateral Construction Costs (Continued)

By Charles W. McKay, Associate Editor*

In the July issue we considered the following items of collateral construction cost.

General and legal expense during construction.

Engineering and general supervision during construction.

Taxes and insurance during construction.

Interest during construction.

In summing up this phase of the subject (and again referring to the percentage method of computing the above items) a table showing the range of values—or percentages—which may be assigned to the various elements, may prove of interest. Such a table is presented in Fig. 37.

**General and legal expense during construction—2% to 6% of the total of the direct construction costs.**

**Engineering and general supervision during construction—5% to 9% of the total of the direct construction costs.**

**Taxes and insurance during construction—3% to 5% of the total of the direct construction costs.**

**Interest during construction—5% to 8% of the total of the direct construction costs.**

**Total collateral, or indirect construction costs—15% to 28% of the total of the direct construction costs.**

*Figure 37*

*Range of Percentages Used in Computing Collateral Construction Costs*

In addition to the items of collateral construction cost—which we have already discussed, there is still another which sometimes merits consideration in connection with the evaluation of a telephone property—namely, Contractor's Profit. Frequently, in connection with the construction of a telephone property, it is cheaper to sublet certain portions of the work than to have the work done by the operating company, or, if we adhere strictly to the reproduction cost theory, we should refer to the "general construction company" rather than to the "operating company." The reason for this should be obvious. Certain types of telephone construction work are so highly specialized that they can be done more cheaply by a contractor (who specializes in work of the nature in question) than by the operating company or by a general construction company. As an illustration of the foregoing we may cite the case of underground conduit construction. Especially, if large amounts of subway are involved it is quite probable that the work can be done to better advantage (more economically) by sub-letting the work to a local contractor, preferably one who has had experience in electric light conduit construction work. The writer suggests a contractor who has had experience in electric light work, due to the fact that electric light and telephone conduit systems usually are very similar.

If the basis of appraisement is predicated upon the assumption that contractors, or sub-contractors, have been employed, an allowance must be made for contractor's profit. In other words, the inventory quantities should be appraised in the usual manner, applying unit costs, and to the totals involved there should be added a certain percentage to cover the honorarium allotted to the contractor. Contractor's profit is usually taken at ten per cent of the reproduction cost of the portion of the plant involved, although it may range from ten to forty per cent, dependent upon the exigencies of the case in question.

Just a word, at this juncture, as to the depreciation of the items of collateral construction cost. It is customary to depreciate the collateral costs in the same ratio as the items of direct construction cost. Possibly this point may be made clearer with the aid of a simple illustration such as the one presented in Fig. 38.

In Fig. 38, it will be noted that the total present value of the direct construction costs is $83,000 as compared with a $100,000 reproduction cost. In other words, the average condition per cent of the inventoriable property is eighty-three per cent. If we apply this percentage to the total reproduction cost of the collateral items ($20,000) we have a corresponding present value of $16,600. It will be noted that an allowance for the non-physical assets has been included in Fig. 38—this to direct the reader's attention to the fact that the non-physical assets are non-depreciable. It will be noted that the figure $24,000 appears in both columns.

In concluding the discussion of collateral construction costs may the writer again direct the reader's attention to the fact that all of the items of collateral cost are just as much a part of the total physical property as are the items component to the total of the direct construction costs. However, despite this fact, they cannot be allocated readily to the unit costs. The reason for this will be apparent if we but consider the unit cost for a thirty-five-foot pole, for instance. After we have built up the total material and labor costs; added suitable allowances for waste, loss and breakage; made further allowances for omissions, contingencies, purchasing, tool expense, etc., we are still confronted with the problem of making adequate provision for the items of collateral cost, i. e., general and legal expense, engineering and general supervision, taxes and insurance during construction and interest during construction. While we appreciate fully that interest, tax, insurance (etc.) charges will accrue against the pole up until the time it becomes a part of the operating plant, we cannot well compute these charges (properly allocated) for an individual unit of plant, such as the thirty-five foot pole under consideration. Hence,

| | Reproduction Cost | Present Value |
|---|---|---|
| Total Direct Construction Costs | $100,000.00 | $ 83,000.00 |
| Total Collateral Construction Costs | 20,000.00 | 16,600.00 |
| Total Physical Property | $120,000.00 | $ 99,600.00 |
| Total Non-Physical Assets | 24,000.00 | 24,000.00 |
| | $144,000.00 | $123,600.00 |

*Figure 38*

*Mr. McKay is Manager of the Valuation Division of The Roberts-Pettijohn-Wood Corporation, Consulting Engineers, 646 North Michigan Avenue, Chicago.

we must compute the items of collateral cost for the plant as a whole rather than to attempt to allocate them to the individual unit costs.

### Chapter XVIII—Non-Physical Assets

Early in the present series, the various items component to the total non-physical assets of a telephone property were discussed in a preliminary manner. It will be remembered that certain definitions were given as to the true significance of the terms "Going Value," "Cost of Establishing Business," "Cost of Financing," etc. As a preface to the present, more detailed, consideration of this phase of our subject, it may be well to review briefly the subject matter already presented. In arriving at the total value of a telephone property—as a going concern—we have much more to consider than the value of purely physical property. For convenience, we have termed the remaining elements of value the "non-physical assets." Frequently they are referred to collectively as the "intangible values." Throughout this series of articles the writer has purposely refrained from the use of the word "intangible"—this for the reason that it almost invariably creates an unfavorable impression in the minds of courts and commissions. Anyone who is at all familiar with rate case procedure knows that many obstacles are encountered in "proving-in" such items as omissions, contingencies, direct supervision, and the various elements of collateral cost. If one has been reasonably successful in convincing a commission or court as to the propriety of including the aforementioned items, he certainly does not wish to run any risk of upsetting the program by interjecting a group of items (however real they may be) referred to collectively as "intangibles." The very word "intangible" suggests something unreal or illusive—while the items which should be grouped under the collective caption "non-physical assets" certainly have a real and tangible value.

Let us first consider the most important item—Cost of Establishing Business, or Going Value as it is sometimes called. It is thought that an apt illustration may serve our purpose better than a definition in explaining the true significance of Cost of Establishing Business. Such an illustration may be drawn from the testimony of Mr. Kempster B. Miller in a now famous rate case. Mr. Miller's testimony follows:

"It is self-evident that a physical plant with a well-established business is worth more than the same physical plant without any business. This element of value, over and above the bare value of the physical plant, I have included under the heading of cost of establishing business. It is sometimes called going value. That such a value exists is indisputable, and, besides being a self-evident fact, has been upheld by courts of highest resort.

"In appraising the physical property, we proceeded upon the basis that the best measure of its value was what it would cost to reproduce it. I have followed this same procedure in appraising the value of the business attached to the physical plant by calculating as closely as possible what it would cost to reproduce the business that existed on the date of appraisal.

"I may, perhaps, make the theory upon which I proceeded clearer by a simple analogy. A man who desired to invest his money in a large office building might enter into an agreement with a contractor to construct the building and turn it over to him at a given date at a fixed sum.

"In this case the amount so paid would constitute the cost of the physical property. This amount, however, would be only a part of what the owner would have to pay in order to produce a building filled with tenants and established on a going basis. In order to fill his building with tenants and place it on an income-producing basis, it will be necessary for him to organize his operating force and sell his space, meanwhile operating the building, keeping it warm, running the elevators, and supplying the attendant, janitor and other operating services.

"Instead of contracting for the bare building, the owner might include as a part of his agreement with the contractor the turning over of the building full of tenants and completely organized as a going concern. In this case it is perfectly obvious that the contractor could not deliver the building at as early a date nor for the same amount of money as when his task was confined to the production of the bare building alone.

"As the building approached completion he would be required to have agents at work securing leases from prospective tenants. He would be required to secure an adequate operating force for the building, consisting of a competent building superintendent and his office force, a building engineer and his subordinates, including elevator men, a suitable janitors' force, and, in fact, a complete organization necessary to keep the building warm and clean, and to carry out all of the other functions required. All this would have to be done before the tenants actually began to occupy the building.

"After the actual opening of the building, and until such time as the number of tenants required by the contract were secured, the contractor would be forced to pay all operating expenses, which at the beginning would be largely in excess of the rents received. As tenants were secured, the revenue would begin to grow, but it is probable that the contractor would be forced to give a certain amount of rent free during the early stages of the occupancy of the building. Such revenues as were received would, of course, flow to the contractor as an offset against the expenses. It is inevitable, however, that the sum total of the financial results during the business development period would be a loss, and, together with the interest thereon, would become a part of the cost to the contractor.

This total cost to the contractor, plus the contractor's profit, would be added to the investment of the owner at the time he took over the building. In this case the difference between this larger cost of the building full of tenants, and of the cost of the physical property alone, would constitute the cost of establishing business, and would, in my judgment, be a good measure of the going value."

This subject of the value of the non-physical assets is most important and will be discussed in some detail in the September and October installments of this series.


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## MAGNETISM (F-1-20)

### Magnetic Circuits

GENERAL. Surrounding every current carrying conductor there is a magnetic field which maintains a definite direction in regard to the current flow and which is directly proportional to the value of the current and inversely proportional to the distance from the conductor. The plane of the flux is at right angles to the flow of the current.

As with an electric current, the magnetic follows a law very similar to Ohm's law and contains factors which correspond to the electromotive force, rate of flow and resistance. The magnetizing force is expressed in Gilberts per centimeter and is the force tending to set up the field. The reluctance or resistance offered to the establishment of the field depends upon the material used, and length of the magnetic circuit just as in the electric circuit. The flux density per square centimeter of core cross-section, expressed in Maxwells, corresponds to current density per unit of cross-sectional area in an electric conductor. The flux density depends upon the reluctance and magnetomotive force (Magnetizing force) according to practically the same law as Ohm's law. Thus,

Let H = magnetizing force in Gilberts per centimeter of length,
v = reluctance of circuit (resistance),
B = flux density per square centimeter of section in Maxwells,
Then B = H/v. H = Bv.

The total flux through the section of the core ($\Phi$) with an area of (A) square centimeters becomes,

$\Phi = AB$ Maxwells.

The total reluctance of the complete magnetic circuit is equal to the sums of the reluctance of the total length of the iron or steel core (if a core is used) plus the reluctance of all air gaps in the magnetic circuit. The reluctance of an iron or steel core is a variable quantity depending upon the chemical composition and physical condition of the metal and upon the length of the metal path in the circuit.

MAGNETIZING FORCE (MAGNETOMOTIVE FORCE). The value of the magnetizing force at any point along a straight conductor is expressed by:

$$H = \frac{2I}{10x} \cos a, \text{ Gilberts per centimeter.}$$

Where: I = magnetic current in amperes.
x = distance of assumed point of reference, (p) from conductor measured perpendicular to conductor length (centimeters).
a = angle subtended by distance (x) and half of the length of the conductor.

When angle (a) is very small, due to close proximity of reference point to conductor, the value of (cos a) is also very small, and

$$H = \frac{2I}{10x}$$

As the flux surrounds the conductor uniformly in the form of a sheath, the flux can be considered as a circular tube, the distance of the center of the flux tube to the conductor being expressed by (x) as before. The length of the tubular ring of flux is the length of the magnetic field surrounding the conductor, hence the mean length of the path is expressed by:

$$x_m = 6.2832x, \text{ and } x = \frac{x_m}{6.2832}$$

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F-1-20

# MAGNETISM (F-1-21)

## Magnetic Circuits

MAGNETIZING FORCE. Knowing the mean or average length of the magnetic circuit from the last equation (in centimeters), we can introduce this length to determine the magnetizing force (H) per centimeter of length of the magnetic circuit.

$$H = \frac{1.2566I}{x_m} \text{ in Gilberts per centimeter of length,}$$

or for (n) conductors acting jointly, we have:

$$H = \frac{1.2566_{n}I}{x_m}$$

MAGNETIZING FORCE IN RING CONDUCTOR. When the conductor is turned up in the form of a circular ring with a radius (r), the flux is concentrated within a smaller area than with a straight conductor and we have,

$$H = \frac{6.2832r^2I}{(\sqrt{r^2 + x^2})^3} \text{ Gilberts per centimeter along axis.}$$

Where: r = radius of ring conductor in centimeters taken from center of ring to center of conductor,
x = mean radius of flux tube as before (Centimeters),
I = current in amperes.

When (x) is very great compared with (r), that is, when the mean radius of the flux surrounding the conductor is large compared to the radius of the ring, then

$$H = \frac{6.2832r^2I}{x^3}$$

MAGNETOMOTIVE FORCE IN HELIX. A continuously wound coil consisting of a number of turns of wires or conductor wound in helix or screw thread form is the most commonly used magnetizing winding. Here the magnetizing force is expressed by:

$$F = 1.2566 \text{ NI in Gilberts (m.m.f.)}$$

Where: N = number of turns of conductor,
I = amperes.

Here we have the term "magnetomotive force" (m.m.f.) which numerically is equal to the magnetizing force which will establish a flux of one Maxwell per centimeter cubed of air. The length dimension is incorporated within this unit, hence the length is not expressed in the result (F) above. Thus, the result in Gilberts is the "lines" of force sustained in a cube measuring one centimeter in length and one centimeter in width and depth of section. For long coils the above equation is practically true throughout the entire length of the coil as the effects of end leakage are relatively small.

PERMEABILITY-RELUCTANCE. So far we have considered only an air core which has a constant reluctance under nearly all conditions and in which the reluctance is comparatively very high. The reluctance is equivalent to resistance in an electric circuit, and the reciprocal of reluctance known as "permeability" is equivalent to "conductivity" in an electric circuit. Very often it is more convenient to use the "permeability" rather than its reciprocal reluctivity. In an iron core, the permeability is greater than with air, but is a variable quantity, changing with the nature of the iron and with the comparative flux density or magnetic saturation of the core.

Let R = reluctance of magnetic material,
L = length of magnetic,
A = cross-sectional area of core,
k = coefficient of material and other conditions, then,

$$R = k\frac{L}{A}$$

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# STANDARD SCREWS (BB-10-37)

## Rolled Screw Threads—Wood Screws

GENERAL. Rolled screw threads are produced by rolling ridges into the blank rods which raise enough of the material above the normal surface of the blank to form the threads. This is a much cheaper process than cutting threads with dies or by other cutting processes.

WOOD SCREWS. The following tables cover the general dimensions of the wood screws made in this country, and a third table is included which covers the dimensions of lag screws used in large timbers.

AMERICAN SCREW CO.'S STANDARD WOODS SCREWS

| No. of screw | Diameter | Threads inches | No. of screw | Diameter | Threads inches | No. of screw | Diameter | Threads inches |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.058 | 32 | 11 | 0.203 | 12 | 22 | 0.347 | 7 |
| 1 | 0.071 | 28 | 12 | 0.216 | 11 | 23 | 0.361 | 7 |
| 2 | 0.084 | 26 | 13 | 0.229 | 11 | 24 | 0.374 | 7 |
| 3 | 0.097 | 24 | 14 | 0.242 | 10 | 25 | 0.387 | 7 |
| 4 | 0.110 | 22 | 15 | 0.255 | 10 | 26 | 0.400 | 6 |
| 5 | 0.124 | 20 | 16 | 0.268 | 9 | 27 | 0.413 | 6 |
| 6 | 0.137 | 18 | 17 | 0.282 | 9 | 28 | 0.426 | 6 |
| 7 | 0.150 | 16 | 18 | 0.295 | 8 | 29 | 0.439 | 6 |
| 8 | 0.163 | 15 | 19 | 0.308 | 8 | 30 | 0.453 | 6 |
| 9 | 0.176 | 14 | 20 | 0.321 | 8 | | | |
| 10 | 0.189 | 13 | 21 | 0.334 | 8 | | | |

ASA S. COOK CO.'S STANDARD WOOD SCREWS

| No. of screw | Diameter | Threads inches | No. of screw | Diameter | Threads inches | No. of screw | Diameter | Threads inches |
|---|---|---|---|---|---|---|---|---|
| 0 | 0.058 | 30 | 9 | 0.176 | 14 | 18 | 0.295 | 8.0 |
| 1 | 0.071 | 28 | 10 | 0.189 | 13 | 20 | 0.321 | 7.5 |
| 2 | 0.084 | 26 | 11 | 0.203 | 12.5 | 22 | 0.347 | 7.5 |
| 3 | 0.097 | 24 | 12 | 0.216 | 12 | 24 | 0.374 | 7.0 |
| 4 | 0.110 | 22 | 13 | 0.229 | 11 | 26 | 0.400 | 6.5 |
| 5 | 0.124 | 20 | 14 | 0.242 | 10 | 28 | 0.426 | 6.5 |
| 6 | 0.137 | 18 | 15 | 0.255 | 9.5 | 30 | 0.453 | 6.0 |
| 7 | 0.150 | 17 | 16 | 0.268 | 9 | | | |
| 8 | 0.163 | 15 | 17 | 0.282 | 8.5 | | | |

LAG SCREWS. These screws range from ¼ inch to 1 inch in diameter and are generally provided with square heads similar to those of a stove bolt. At the present time there is no rigidly accepted standard and the screws are listed according to two principal systems, designated here as "A" and "B."

LAG SCREW THREADS

| Diameter inches | Threads per inch (A) | (B) | Diameter inches | Threads per inch (A) | (B) | Diameter inches | Threads per inch (A) | (B) |
|---|---|---|---|---|---|---|---|---|
| ¼ | 10 | 10 | ½ | 6 | 6 | ¾ | 4½ | 5 |
| 5/16 | 9½ | 9 | 9/16 | 6 | 6 | ⅞ | 4½ | 4 |
| 3/8 | 7 | 8 | 5/8 | 5 | 5 | 1 | 3 | 4 |
| 7/16 | 7 | 7 | 11/16 | 4½ | 5 | .. | .. | .. |

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# Tuning Radio Apparatus

## Explanation of Wave Lengths, Mutual Inductance and How to Build Wave Trap—Units Available for Tuning—Some Suggestions Concerning Fixed and Variable Condensers

By R. T. Cloud

To the novice, the first reaction to the operation of a radio receiving set is surprise that one does not hear all the stations that are in operation at the time. He then goes to the other extreme and expects radio engineers to produce an instrument that can pick up any desired station at will without any interference whatever regardless of the wave length of the interfering station. Of course, this is electrically impossible where two stations are on exactly the same wave length and of about the same signal strength.

However, with slight differences in wave lengths or frequency, the expert radio engineer has been able to do wonders.

It is not only by utilizing the principles of resonance but by taking into consideration also high frequency resistance, stray capacities, etc., that he is able to take a small current measured in millionths of amperes, preserve it and magnify it until it can be heard sometimes for miles with no appreciable distortion.

To a person somewhat versed in alternating current theory as used in power and telephone practice, there are a few connecting links that will enable him to apply this knowledge to radio work. One of these is a thorough understanding of what is meant by the term wave length, usually expressed in the metric term meters.

Unfortunately, early experimenters, instead of using the usual frequency term of "cycles" per second, used the term "wave length," which is rather confusing to a person versed in alternating-current calculations of power and telephone work. The recent decision of the United States Department of Commerce to use the term kilocycle or thousands of cycles per second is a move in the right direction and the probability is that in time the term "wave length" will be abandoned.

However, once the physical meaning of wave length is understood it is easy to convert wave length to cycles per second, or vice versa.

### The Theory of Radio Is Simple

When a condenser of large dimensions, or in other words an antenna, is excited by an alternating current at radio frequency a wave is propagated into space. These waves consist of alternating electrical stresses which travel through space much as a wave travels on a slack rope when sharply given an up and down movement at one end, or as a ripple spreads on water.

These waves travel at the speed of light, or at the rate of 300,000,000 meters per second. Now, assume that the transmitting antenna is excited by an alternating current of 1,000,000 cycles per second (1,000 kilocycles); then, at the end of one second from the time of application, the first radiated wave has reached a point 300,000,000 meters from the sending station. But, between this wave and the station are 999,999 other waves of a similar nature; or, in other words, we have evenly distributed over a space of 300,000,000 meters, 1,000,000 waves or alternations of stress on the ether. Now, dividing 300,000,000 meters by 1,000,000, we obtain 300 meters, or the space occupied by one wave of the train. We thus speak of a station sending out such waves as operating on a 300 meter wave length. Likewise, given the wave length, we can determine the frequency by dividing 300,000,000 by the wave length which in the above case would equal 1,000,000. A wave length of 600 meters likewise corresponds to 500,000 cycles and one of 200 meters to 1,500,000 cycles. Thus, having the means at hand of converting radio terminology to alternations per second, formulae applicable to alternating current phenomena are available for use in radio calculations.

### Tuning Is a Resonance Effect

It is by means of the phenomena of resonance that all tuning of electric waves is accomplished. Just as every material object having elasticity and mass has a natural period of vibration, so every electrical circuit containing inductance and capacity has a natural period of electrical vibration.

In the electrical case, inductance acts the same as mass, and capacity furnishes the elasticity. At the natural period, it is easier to overcome the resistance of the body to motion or, in the case of an electrical circuit, to overcome the resistance of the system to electric current flow.

An interesting experiment is to go to the piano, place your foot on the loud pedal so as to lift all the stops from the strings allowing each string free to vibrate on its own natural period then sing some one note, for example middle C. Then, place your ear near the strings and you will find that the middle C string is vibrating from the force of your voice no other strings will be found to be vibrating.

### How to Get Various Values

With combinations of capacity and inductance, we can build up electrical systems that will respond to any given frequency or wave length; or, as is generally the case, we can, by making one or both elements variable, vary the electrical response of the system over a considerable range of values.

Given certain values of inductance and capacity, the frequency at which the combination is most responsive is determined by the formula:

$$f = \frac{1}{2\pi\sqrt{LC}}$$, where f = frequency in cycles per second, $\pi = 3.1416$, L = Inductance in, C = Capacity in farads; or, expressed in units better adapted to radio frequencies:

$$f = \frac{5033}{\sqrt{\text{milhenry C microfarad.}}}$$

In some cases, you may prefer to work with this formula directly in terms of wave lengths, in which case wave length = $59570\sqrt{\text{L milhenry C microfarad.}}$

The above relation as regards maximum response holds for inductance and capacity in series. When inductance and capacity are in multiple, the same formulae determine the resonant frequency but the effect of such a combination is to present a very large impedance to the circuit. In fact, if the ohmic resistance of the two elements were zero, the impedance presented would be infinite. This is because the currents in the condenser and coil are in opposite directions and tend to neutralize each other. Such a circuit combination is called an anti-resonant circuit in contradistinction to the series or resonant combination.

A circuit containing no inductance

or capacity, merely ohmic resistance, is called an aperiodic circuit.

All tuned circuits are built up of resonant or antiresonant combinations, depending upon whether or not you wish the radio frequency currents to flow through the portion of the circuit in which the element is to be inserted.

Thus, the aerial capacity can be combined with inductance so as to form a series resonant circuit, for you wish to cause the maximum current flow in this portion of the circuit. In the case of a

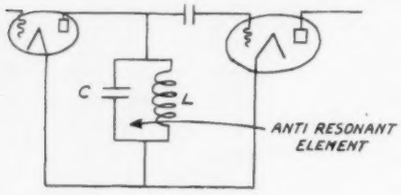


FIG. 1

coupling between two tubes as shown in Fig. 1, which is the well known tuned impedance coupling for radio frequency amplifications condenser C and inductance L form an antiresonant combination that presents a very high impedance to the high frequency output of first tube, thus passing it on to the second tube with very little diminution in volume.

### Concerning Mutual Inductance

Two or more inductances may be arranged so that their magnetic fields interlink, in which case all of the well known transformer relations take place and we have to take into account the effect of mutual inductance which is added to the self inductance of the coil. The mutual inductance between two coils may be varied by varying the distance between two coils or by changing the angular relation of one with regard to the other. A certain amount of tuning may be done in this manner.

### How to Build Wave Traps

Another example of the anti-reso-

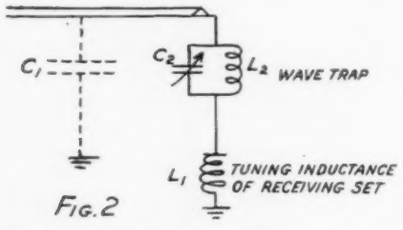


FIG. 2

nant combination is the wave trap which consists of a suitable combination of inductance and capacity tuned so as to prevent a certain frequency from entering the system. A very common method is to insert the wave trap in the antenna circuit as shown by accompanying diagram: Fig. 2.

In this case, the anti-resonant combination $C_2$ $L_2$ is so chosen as to keep out the interfering wave while the combination of $L_1$ $C_1$ is such as to cause the maximum flow at the frequency it is desired to receive. A more effective method of inserting a wave trap in a circuit is shown herewith in Fig. 3, where it is inserted in the grid circuit of the first tube.

In this case, the wave trap is not shunted by the aerial capacity and consequently tunes sharper.

A wave trap, to be effective, must tune sharply therefore, the elements—especially the inductance—must present a low ohmic resistance. The same considerations govern the choice of this inductance as those required for any tuning inductance. Use either single layer or bank-wound coils, wire not smaller than No. 24 B & S, or else use honeycomb or duolateral wound coils.

### Units Available for Tuning

Inductances usually consist of a coil of wire with an air core; either a single layer or bank wound coil on a tube, or a honeycomb or duolateral coil.

Where coils are home-made, the most general type is the single layer solenoid. As these are almost always tapped or used in connection with variable condensers, it is not neces-

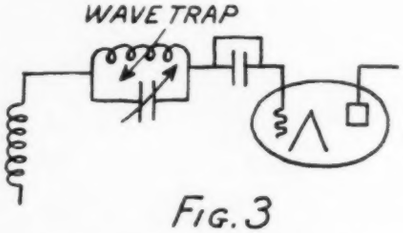


FIG. 3

sary to determine the inductance values with extreme accuracy.

An approximate formula for a single-layer inductance coil is given by the U. S. Bureau of Standards as follows:

$$L = \frac{39.48\, a^2 n^2}{b} K,$$

L = inductance in milhenrys, n = number of turns of winding, a = radius of coil measured from axis of coil to center of any wire in centimeters, b = length of winding in centimeters, K = is function of $\frac{2a}{b}$ and is given by table below:

| Diam.÷ length | K | Diam.÷ length | K |
|---|---|---|---|
| 0.00 | 1.0000 | .65 | .7745 |
| .05 | .9791 | .70 | .7609 |
| .10 | .9588 | .75 | .7478 |
| .15 | .9391 | .80 | .7351 |
| .20 | .9201 | .85 | .7228 |
| .25 | .9016 | .90 | .7110 |
| .30 | .8838 | .95 | .6995 |
| .35 | .8665 | 1.00 | .6884 |
| .40 | .8499 | 1.05 | .6777 |
| .45 | .8337 | 1.10 | .6673 |
| .50 | .8181 | 1.15 | .6573 |
| .55 | .8031 | 1.20 | .6475 |
| .60 | .7885 | 1.25 | .6381 |

This formula is also roughly approximate for 2- or 3-layer bank windings where an accuracy within 5 per cent is allowable.

Many prefer to use the machine-wound, honey-comb or duolateral windings, a table of which inductance values is given herewith for duolateral coils. These coils are wound on a spool 2 inches in diameter and one inch long:

| Number of turns | Inductance Milhenrys |
|---|---|
| 25 | .0390 |
| 35 | .0717 |
| 50 | .149 |
| 75 | .325 |
| 100 | .555 |
| 150 | 1.30 |
| 200 | 2.31 |
| 250 | 3.67 |
| 300 | 5.35 |
| 400 | 9.62 |
| 500 | 15.50 |
| 600 | 21.6 |
| 750 | 34.2 |
| 1000 | 61.0 |
| 1250 | 102.5 |
| 1500 | 155. |

### Fixed and Variable Condensers

We have available for tuning, both fixed and variable condensers. In selecting fixed condensers, do not place too much dependence in the values marked by the manufacturer as there is considerable variation in these; also, do not use paraffine-paper-insulated condensers as these are not always constant and absorb considerable moisture, varying their insulation resistance.

Variable condensers, as generally made, consist of semicircular plates arranged to interleave by rotation. Their capacity values depend on the size of the plates, the number of plates and the spacing of plates.

Where accurate values are required, it is best to obtain a good variable condenser calibrated by the manufacturer, or else calibrate by direct comparison with a suitable standard. However, it is well to remember that none of these condensers is at zero capacity at minimum setting. Roughly, the average condensers have maximum and minimum capacities as shown herewith:

| No. of plates | Min. cap. Microfarads | Max. cap. Microfarads |
|---|---|---|
| 11 | .00010 | .00025 |
| 23 | .00015 | .0005 |
| 43 | .00020 | .001 |

FIG 1

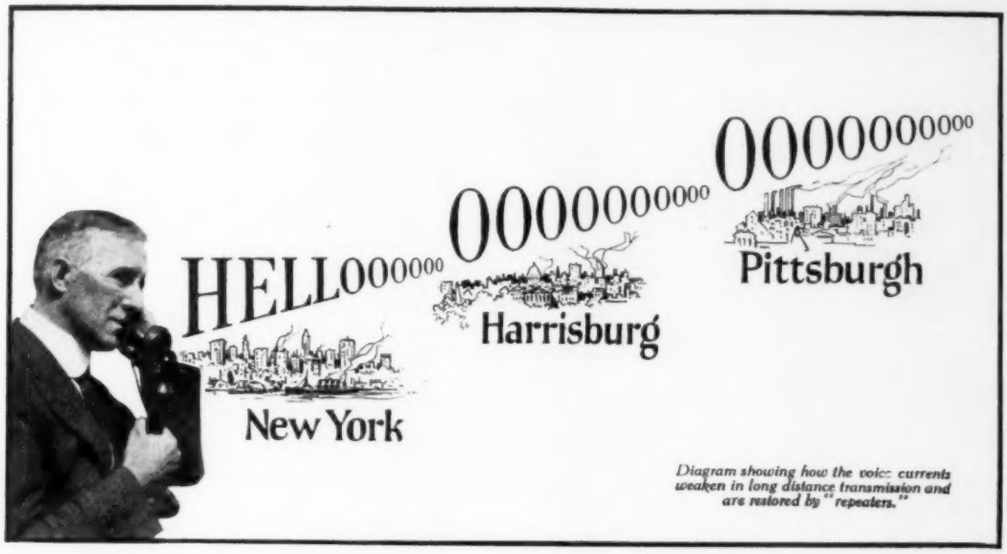


*Diagram showing how the voice currents weaken in long distance transmission and are restored by "repeaters."*

# Mastering Nature's Forces

Without the telephone "repeater," the entire electrical power available on the earth would not be sufficient to make trans-continental speech commercially possible. The three thousand repeaters now in use on Bell System long distance lines have increased the talking range of every telephone by thousands of miles. By making possible the use of smaller gauge wires, repeaters have kept down the cost of equipment by millions of dollars.

The repeater is only one out of scores of scientific developments of equal or greater importance in the advancement of telephone service. Bell System progress has been a continual encounter with seemingly impossible barriers, and a continual finding of new ways to overcome them. Each step in extending the range of speech has come only after years of study. Each important piece of telephone apparatus has had to be created for the need. Each working day this pioneering goes on. Nature is harnessed to a new duty and mechanical ingenuity improves the tools of service, as fast as science finds the way.

Not only is the Bell System daily conducting research within its own nation-wide organization, but it is studying the discoveries of the whole world of science for their possible application to telephone service. Only by such eternal vigilance has the United States been given the best and cheapest telephone service in the world.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

***One Policy, One System, Universal Service, and all directed toward Better Service***

### *Homestead Buys Dade County, Fla., Company*

Miami, Fla.—Negotiations for the purchase of the Dade County Telephone Co. by a group of Miami, Fla., men, headed by President Frank B. Shutts of the South Atlantic Telephone & Telegraph Co., were closed recently, when an agreement was signed by President G. W. Moody of the Homestead company and other officials.

The improvement program which has been tentatively mapped out by the new holding company, provides for an extended, efficient service between Miami and Homestead and vicinity. Installation of the three new copper lines between Miami and Homestead will provide adequate service during the coming winter season for the outlying towns and hamlets in Dade county, F. W. Webster, vice-president and treasurer of the Homestead Telephone company, announces. Mr. Webster says that the work of installing these new lines probably would be completed by November 1. He said there are at present 350 subscribers in Homestead and in the dozen smaller places south of Larkins which would be benefited by the improvement program.

The personnel of the Homestead Telephone company, in addition to President Shutts and Vice President Webster, comprises Gilett S. Webster, secretary, and Julian H. Webster, manager. The latter formerly of Fort Valley, Ga., has removed to Homestead and will direct the operation of the plant there.

### *College Professors Get the Facts*

Leading educators of scientific schools are spending five weeks of their Summer vacation studying electrical equipment production facts at the East Pittsburgh and South Philadelphia Works of Westinghouse Electric & Manufacturing Co. The object of the conference is to bring the various participants as closely in touch with the latest production methods which gives them a broader viewpoint of industry in general so that they may be better fitted for teaching their respective subjects. Each professor may specialize in some particular activity of his own choice, either design, application, production or test. At the same time the group participates in a daily conference with one of the departmental heads.

The members of the conference specializing in various phases of electrical equipment are:

H. B. Beckwith, Instructor of E. E. Kansas State Agriculture College.

C. W. Beese, Asst. Prof. Ind. Eng., Pennsylvania State College.

E. A. Bureau, Asst. Prof. Elec. Eng., University of Kentucky.

Walter Criley, Instructor of E. E. University of Pennsylvania.

A. H. Forbes, Asst. Prof. Elec. Eng., Pennsylvania State College.

R. B. George, Assoc. Prof. E. E. Mississippi A. & M.

W. R. Harding, Instr. of Physics, Purdue University.

H. E. Hazen, Instr. of Elec. Eng. University of Vermont.

A. S. Hill, Assoc. Prof. E. E. University of Maine.

G. L. Hoard, Instr. of Elec. Eng. University of Washington.

Thos. Matthews, Asst. Prof. Elec. Eng. University of N. Dakota.

M. J. Maxfield, Instr. of Elec. Engr. Pratt Institute.

F. R. Maxwell, Assoc. Prof. E. E., University of Alabama.

### *Reduced Rates and Special Trains for T. P. A.*

The passenger associations have granted the Telephone Pioneers of America the privilege of reduced railroad rates of a fare and one-half on the Identification Certificate Plan for the Atlantic City Meeting, October 19 and 20. The rates are available to all Pioneers and members of their families accompanying them. These tickets will be on sale (from all points) for the going-trip from October 16th to 20th, both dates inclusive; and the return journey must be completed on or before midnight of October 26th, excepting from distant points, where the time is extended.

Arrangements are being made for Special Trains from Chicago and Western points and New York; also Boston and New England points.

### *New Pumping Outfit Fits Telephone Work*

The "Penway" Pumper, manufactured by the Pennsylvania Pump & Compressor Company, Easton, Pa., is claimed by its makers the first real portable outfit. Also as a stationary outfit or for use in close quarters, it has attractions occupying as it does about one-fourth of the usual floor space required by a pump of its capacity. The capacity of the pump is 350 gallons per minute at 20 ft. head. The capacity will vary throughout the range of total head produced delivering approximately 50 gallons per minute at 35 ft. total head. The total weight of the complete pumper without truck is 500 lbs. The complete outfit as illustrated weighs 780 pounds. The overall dimensions of the complete unit are 30'x19"—floor space, 36" high. There are no gears, pulleys, belts; not even a coupling; nothing to get loose, shear or get out of line in the Penway outfit its makers state. The "Penway" Pumper is of the single stage, side suction type with open impeller, the back and edge of impeller and interior surface of the casing are accurately machined to template, insuring the proper uniform clearance between the rotating and stationary elements. The engine shaft extends into the pump casing and the impeller is mounted upon its end. That portion of the shaft extending into the pump and exposed to the action of the liquid being pumped, is covered with a bronze sleeve to prevent corrosion and is easily renewable if necessary. The engine is the New-Way 5 H.P. Air Cooled Gasoline Engine manufactured by the "New-Way" Motor Company of Lansing, Michigan. This engine is of unique design. The cylinder is cooled by the "New Way" patented method of cooling directly by air with all of the unnecessary parts of the water-cooled method eliminated. There are no frozen cylinders, no circulating pump to clog, no piping nor hose to leak, no water to haul, no steaming hopper jackets and no water to boil away and cause the engine to overheat. The engine is of the four cycle type, equipped with the Bosch High Tension Magneto and Impulse Starter, making the engine extremely easy and sure to start.

*Penway Pumper, Mounted on Truck*

### *Rush Job Installing Coolidge Telephone*

At 3 A. M., August 3, linemen of the New England Telephone & Telegraph Co., in charge of District Superintendent W. T. Durfee and E. S. Blakely of Rutland and Charles Sawyer of White River Junction, began work on a direct line from President Coolidge's father's home to Washington. In half an hour the linemen had connected with the telephone trunk line running from White River Junction to Bellows Falls and had installed a telephone instrument in the dining room of the Coolidge home, where no telephone had been before.

This circuit completely tied up one of the three telephone circuits running from the neighborhood of Plymouth, Vt., to New York and Boston, and increased the difficulty of transmitting information to the newspapers and press associations.

**3 TYPES OF SWITCHING APPARATUS X 3 TYPES OF CONTROL APPARATUS = 9 COMBINATIONS FILLING EVERY REQUIREMENT**

## NORTH SWITCHING APPARATUS

ALL SWITCH—Step-by-step and rotary.

PART RELAY—Relays replace switches at vital points.

ALL RELAY—Both step-by-step and rotary switches entirely eliminated.

*Any of the three general types* of switching apparatus above listed can be driven by *any of the three types* of control apparatus listed on this page.

## NORTH CONTROL APPARATUS

AUTOMANUAL DESKS with necessary additional apparatus.

AUTOMANUAL DIALS, driving practically the same apparatus direct from the subscribers' stations.

SATELLITE remote control desk located in distant main office or dial control.

*Any of these three types of control* apparatus will, with certain simple circuit changes, operate *any of the three types* of switching apparatus here listed.

### Send for Complete Details

Every installation of North Switching and Control Apparatus has, as its objective, Better Service with Greater Profit. How this is accomplished is an interesting story. We are glad to work with you in assisting to select the method that best meets your needs.

*The*
# NORTH ELECTRIC
## MANUFACTURING COMPANY
## GALION, OHIO

The North line offers every variation of automatic telephone service, including the Automanual System for local and toll service, Automanual remote control of small exchanges, and Dial Automatic for exchanges too small for Automanual. Manufacturers of telephone equipment since 1884.

# Extraordinary Purchases

"There are few businesses, if any," says A. G. Storrs, superintendent of supplies, in "The Northwestern Bell," "that buy as large and varied an assortment of supplies and material as the telephone company. It would be difficult to name an article that is not used in the furnishing of telephone service. From all corners of the earth material is secured." There are more than 4,000 articles listed in Mr. Storr's price book, ranging from "T" pins to telephone poles.

"And in addition," he continues, "we purchase hundreds of other articles that are needed, but which at first thought might seem to have no connection with the telephone business." Included are refrigerators, stoves, camp equipment, baskets, scythes, barrels, boats, snowshoes, skis, boots, garden hose, paint and lawn mowers.

"The heavy snow and sleet storms in the North," says Mr. Storrs, "often block roads for days, making it impossible for trains or automobiles to travel. Telephone service, though, must always be restored promptly, and it is necessary for the telephone men to have snow shoes or skis to go over the deep snow. These are kept on hand where needed, and our experience in the past has proved the economy and wisdom of this practice."

**Unusual Demand Created by Storms**

Storms always result in a demand for unusual supplies. The heavy storm in Iowa March 11 caused a big demand for rubber boots, caps and slickers, on account of the rain and deep, muddy roads. Hundreds of pairs of boots were rushed to the storm area and Iowa was scoured for additional supplies. Quite often telephone crews work in parts of the territory where it is impossible or impractical to secure board or lodging. Equipment, such as tents and cots, is then purchased and camps are set up.

**Some of the Big, "Regular" Items**

Each year an average of $62,000 worth of new furniture and fixtures is purchased by the Northwestern Bell company. New employes and the continually growing demand for telephone service make this expenditure necessary. The upkeep on motor equipment costs about $500,000 a year. More than 300,000 gallons of gasoline, 20,000 gallons of oil and about 2,000 tires were used last year.

About 15,000 tons of coal are required annually to heat buildings in the five states, and approximately $150,000 is spent for electric light and power.

The operators who eat in the lunch rooms might be surprised to learn that nearly 700,000 neat paper napkins are used in Northwestern territory each year.

**And Don't Forget the Office Supplies**

In a business the size of the Northwestern Bell it is necessary to send out thousands of letters and bills each year. Last year sixteen tons of correspondence paper, 3,917,400 sheets, were used. Nearly 6,000,000 envelopes, carrying about $125,000 worth of postage stamps, were necessary. Among the various other articles and supplies used by the company each year are 200,000 pencils, 75,000 pen points, 10,000 erasers, 1,250,000 paper fasteners, 600 pounds of pins, 600 quarts of ink and 800 pounds of rubber bands.

## *International Telephone*

New York City.—International Telephone & Telegraph Co. reports continuation of current earnings of subsidiary companies on improved basis indicated by statement for first quarter would show consolidated net earnings applicable to total stock now outstanding at the annual rate of approximately $9 a share. All floating indebtedness of the company and subsidiaries has been paid off and cash on hand or invested in short term securities is in excess of $2,000,000.

## *One of Every 30 Subscribers, Stockholders*

New York, N. Y.—About one person out of every 46 who has a Bell Telephone owns stock in the A. T. and T. Co. The company now has more than 265,000 registered stockholders. Taking into consideration public ownership of securities in the Bell's associated companies, about one Bell phone user in 30 is a stockholder.

## *Will Build a New Home*

Johnson City, Tex.—The Inter-Mountain Telephone Co. is to have a new home here which will cost $75,000, according to W. M. Cox, manager.

Woodruff, S. C.—E. A. McKee, who has served as night telephone operator for some time, has purchased the controlling stock in the Home Telephone Co., of this place, and has assumed management of the company. New material has been ordered, and Mr. McKee will put the equipment in first-class shape. Elbert Wofford has accepted the position as night operator.

The Southern Bell Telephone & Telegraph Co. have authorized increase in capital stock from $30,000,000 to $50,000,000. The stock is 100 per cent owned within the Bell System.

## *Poor Wire Joints Put Phone Patrons Far Apart*

Oklahoma City.—Recent tests and demonstrations by the Southwestern Bell Telephone Co. on rural telephone lines serving the territory surrounding the city of Claremore, Oklahoma, have shown that the owners of these lines have been cheating themselves badly by failure to maintain good wire joints on some of the lines. All lines were shown to be in need of improvement and their owners are to make the needed repairs at once. It was demonstrated that patrons only eight miles apart were obtaining service equal to that to be expected over fifty-five miles of similar construction. The managers of the lines tested were shown how to improve service over their lines at practically no cost. It was stated in connection with the same demonstration that serious loss of telephone efficiency is caused by loose ear caps on telephone receivers, it being shown that a loss of efficiency as high as 68 per cent can be caused by failure to keep these caps screwed on tightly.

## LEBANON GROWS AND IMPROVES.

Lebanon, Ind.—The Lebanon Telephone Co. has purchased a lot at the corner of Lebanon and North Streets and will begin the erection of a new central office building within the next year. It is expected that complete new central office equipment will be installed. The company has outgrown its present quarters which are located only one-half block from the new location. During the past year, the company has been making numerous cable extensions into outlying portions of the city and now has its plant practically all in cable.

## *Commission Decisions Favorable*

New York, N. Y.—In 90% of the rate increases sought by the Bell during the post-war readjustment period, the commission decisions were acceptable to the utility, says the statement accompanying the earnings report comparing the first six months of 1922 with the corresponding period this year. The half year earnings for 1922 were $40,619,952.51, and for the first half of 1923, approximately $47,047,081.99.

## *Ada, Ohio, Company Makes Improvements*

Ada, Ohio.—Contract for rebuilding of the Ada telephone exchange and for outside wiring which will eliminate overhead wires, has been awarded. The contract calls for an expenditure of $60,000 for laying underground cables in Ada, Harrod, Lafayette, Alger, McGuffey and Dunkirk.

# Cooperative Publicity Pays

## Companies Pool Efforts on Selling Telephone Service and Carbon Paper to the Same List—An Eastern Scheme That Helped Develop Toll Business

By J. E. Bullard*

The season of the year was approaching when sales of office appliances and stationery slow up. Soon it would be harder to get the people into the store and customers who placed their orders with salesmen or sent them in by mail would do so in a more leisurely manner. Already more thought was being given to vacations than to spending money for those things stationers sell.

H. B. Crosby, general manager and treasurer of Thorp and Martin, stationers, was seated in his office talking the matter over with a salesman whom he had found from experience to be just brimful of good selling ideas. The business has been built up to its present position of leadership through the application of advanced selling ideas.

"Randall," said Mr. Crosby, as he took his watch from his pocket, "if we could cooperate in some sort of sales effort with some other concern, not a competitor of ours, both of us ought to be able to gain more through that cooperation than either would working alone. Take the company that makes this watch, for example, I don't suppose we could work out any plan to cooperate with it, but this will illustrate what I mean. Suppose that we could work out some plan by means of which this company working with us could get more business and we could get more people into the store and more people to send in orders. You can see that by working together both of us would gain."

The conference over, Randall began to give the idea serious thought. First, what were the concerns with which the company was doing a good deal of business, both buying from them and selling to them, it would be wise to approach. He had not gone down the list very far before he came to the telephone company. That concern was a good customer of Thorp and Martin Co., and Thorp and Martin Co. was a good customer of theirs.

The telephone company was just introducing the automatic exchange. This looked like a good chance to suggest to the telephone people that they make a display of these new telephones in the window. Thorp and Martin Co. could make a store display of all the things it sold that could be used in connection with a telephone, and a man from the telephone company could show the people just how to use these telephones.

As the plan developed, the better it looked. Accordingly, it was presented to the telephone company. That company did not believe that then was an opportune time to display the automatic telephone. There were various good and sound reasons why it should not be done. No really good reason could be advanced why it should be done.

"But," suggested the telephone man, "we've got something that will make a very much better display and a plan which I think will be better."

Then he went on to explain how a special display board had been constructed, that this would be placed in the Thorp and Martin Co. window, that this board explained toll calls, and that a man would be stationed inside the store to tell the people the best way to make toll calls. This looked like a good idea and this display was decided upon.

When the plan was worked out, Thorp and Martin mailed to a carefully selected list of 5,000 customers, most of them out of town, a book of 25 coupons. Each coupon was good for a toll call from anywhere to Thorp and Martin Co.

No matter how far away from Boston the customer might be, if he needed anything, all he had to do was to call the company by telephone. The order was delivered, the invoice mailed, and when the customer made out his check, he deducted the telephone toll from the amount and attached a coupon to the invoice to cover this deduction. Only one coupon could be used with each invoice.

This naturally speeded up the orders, for instead of the exchange of two or three letters, the whole transaction in regard to an order was handled in a few minutes over the telephone. Besides, when a man had those 25 coupons, which had cost him nothing, each one good for a toll call, there was a strong temptation to use the telephone to take advantage of the offer those coupons made him.

The first day the display was shown in the window, together with a card in-

Telephone Coupon
This coupon will be accepted as cash by us when used in accordance with the instructions on the inside of the cover.
THORP & MARTIN CO.
MAIN 6336
DETAIL OF CALL
Date
Amount of Toll Charge

*"It Built Business for Both Companies"—The telephone company arranged this display in a Thorp and Martin Co. store window and provided telephone coupon books for customers by means of which they could telephone in orders free of charge*

* Reprinted from "System," the magazine of Business.

viting those who saw it to enter the store and learn the best way to make calls, one telephone man was kept busy giving information. Soon, however, the number of people entering the store became so great that more men were needed and before the display was taken out three men were busy all the time answering questions.

This plan had the result of many people coming into the store to gain information about toll calls who would not have gone into the telephone office for the same purpose. The information they gained caused them to use the telephone to a greater extent than they had previously done. The coupon books sent out, good for a total of 125,000 calls, resulted in a direct increase of toll calls for the telephone company. It was good business for that company to make the demonstration.

The large number of people brought into the store, and who would not have come in had it not been for the window display, resulted in an increase in store sales of the various articles displayed in the store which could be used in connection with the telephone. The display was well worth while to Thorp and Martin Co. In addition, these people who came into the store bought other things. Many of them had never been in the store before and a fair proportion of them could be counted on to become permanent customers. Thus far there was no question about the plan being an excellent business-building idea. Both companies had benefited to a greater extent than they would have working independently of each other.

But what about those coupon books? Some of those coupons were mailed a considerable distance from Boston. There was no limit to the cost of the toll they would cover. Some of them might be used for a call costing but 10 cents, while on the other hand, one might be used from Portland, Me., or some other distant point, so distant that with an extended conversation the toll charge would amount to $1, $2, or even more.

At first thought this would seem like a rather risky plan. If a person used a $1 call to order 75 cents worth of goods, there certainly would be no profit in the transaction. However, the plan did work out in a satisfactory manner. No abuse was made of the coupon privilege.

This was due in no small part to the careful manner in which the names on the mailing list were selected. The use of the coupon books was carefully explained and the orders received as a result more than offset the expense. Considering the season of the year, it was cheaper to get the business in this manner than to get it by letters.

### *Cuba's Prize Beauty Is Long Distance Operator*

Havana, Cuba.—Cuba's keenest artistic eyes have picked as the fairest senorita in that lovely land Carmen Fernandez Ramos.

An easy winner in the national beauty contest, the recipient of gifts from the provincial and municipal governments and the newspaper which promoted the beauty contest, the radiant Carmita—as her fellow-employes

*Senorita Carmen Fernandez Ramos, Cuban operator, wins Beauty Prize. This evidence backs up judges*

call her—is still handling calls on the long distance end of the Cuban Telephone Co. at Havana. She told a newspaper reporter who interviewed her that "the only real beauty is that which comes from noble thoughts and a beautiful, cheerful disposition that is so necessary to the success of a telephone operator."

For four years Carmita has been handling long distance calls in the Cuban capital and she intends to stick to her job. The glory that came to her when a margin of 100,000 votes pronounced her the bright and shining star of Cuban pulchritude hasn't turned her head. She maintains that she likes her work, and she's the type of a business woman who sticks to the job.

The accompanying photograph of the charming Carmita doesn't show her in the working clothes of a Cuban operator. It is a Parisian gown that is one of the trophies of her triumph.

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Chicago, Ill.—A copy of the supreme court decision in the case of the Southwestern Bell Telephone Co. vs. Public Service Commission of Missouri, sustaining the reproduction new valuation for telephone companies in rate cases, has been sent to members by the United States Independent Telephone Assn.

## French Phone System

### To Spend 200,000,000 Francs a Year for Ten Years—Rural Service Not Developed

The French government seems to appreciate the necessity for marked improvement in the country's telephone service, and responsible officials comment severely on the inferior service rendered by their telephone system. Toll lines are said to be so unsatisfactory that they hardly are a factor in communication in France. Rural service also is in its infancy. At the end of a recent session officials expressed themselves in favor of: (1) the replacement of aerial wires by cables in interurban service at the earliest possible date; (2) the installing of automatic telephone service; (3) the development of telephone service in the country through the organization of small cooperative companies. The government has put before Parliament a comprehensive plan for the development of the French telephone service involving the expenditure of 200,000,000 francs per year for ten years on new equipment.

### *Refloat Over $100,000,000*

Before the end of October, 1925, five bond and note issues of American Telephone & Telegraph Co. and its associated companies mature:

December 1, 1923, $50,000,000 Chicago Telephone 5 per cent gold bonds come due, and this refinancing already has been arranged for under authority of the Illinois Utilities Commission. This company now is part of the Illinois Bell Telephone Co. and is 98 per cent owned within the Bell system.

February 1, 1924, $40,000,000 5-year 6 per cent gold notes of American Telephone & Telegraph Co. mature; also $10,000,000 20-year 5 per cent first mortgage bonds of Michigan State Telephone Co. The Michigan company is over 99 per cent owned within the Bell system.

### *Ask Permit for Michigan Merger*

Washington, D. C.—The Michigan State Telephone Co. has asked the Interstate Commerce Commission to ratify a transaction by which it will acquire ownership of the Citizen's Telephone Co. which operates in Grand Rapids, Lansing, Battle Creek and other Michigan cities. The Michigan company proposes to pay $3,851,835 in cash for the physical properties of the Citizens' company and to assume $1,453,000 in bonded indebtedness.

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# Are These in Your Library?

As there has been considerable discussion recently about the dearth of good telephone literature, we are pleased to submit the following list of the books now available:

Physics

1. A text-book of Physics, by A. Wilmer Duff, 1911. A good reference book.

2. The Progress of Physics, by Arthur Shuster, 1911.

Mathematics

1. Handbook of Mathematics, by J. Claudel, 1906.

Electricity and Magnetism

1. Elementary Lessons in Electricity and Magnetism, by Silvanus Thompson, 1911. For the beginner.

2. Magnetism and Electricity, by E. E. Brooks and A. W. Poyser, 1912. One of the best and most complete books for the average reader or for reference.

3. The Nature of Matter and Electricity, by D. F. Comstock and L. T. Troland, 1917. Entertaining description of discoveries regarding the electron and theory of matter.

4. Principles of Electrical Engineering, by Harold Pender, 1911. Solid stuff on the fundamentals.

5. Electrical Measurements, by H. S. Carhart and G. W. Patterson, 1895.

6. Swoope's Lessons in Practical Electricity, by C. Walton Swoope, revised in 1920. A good text-book of intermediate grade.

7. Thermionic Vacuum Tube, by H. J. Van Der Bijl. The standard book on the theory and operation of the tube.

Electrical Engineering

1. Electrical Instruments and Testing, by Norman H. Schneider, 1907.

2. Electrical Engineering Leaflets—Intermediate Grade, by E. J. Houston and A. E. Kennelly.

3. Electrical Engineering Leaflets—Advanced Grade, by E. J. Houston and A. E. Kennelly. These leaflets are famous for their clear treatment of the principles.

4. Application of Hyperbolic Functions to Electrical Engineering Problems, by A. E. Kennelly. Very good on theory of telephone and telegraph transmission.

5. Standard Handbook for Electrical Engineers, F. F. Fowle, Editor-in-Chief, 1915. Reference book on all branches.

6. Stray Currents from Electric Railways, by Dr. Carl Michalke (translated), 1906.

7. Motor Troubles (A. C. and D. C.), by E. B. Raymond, 1909.

8. Dynamo Electric Machinery, by Silvanus P. Thompson. Vol I, Continuous Current Machines, 1904; Vol. II, Alternating Current Machinery, 1905.

9. Construction of Graphical Charts, by John B. Peddle, 1910.

10. Engineering Economics — First Principles, by John C. L. Fish. Revised edition of a book recognized as essential to the engineer.

11. Storage Battery Engineering—Lyndon, 1910. Valuable for one wishing to make a special study of this subject.

12. Alternating Current Phenomena—Steinmetz, 1908. Advanced treatise on theory.

13. A Course in Electrical Engineering, by Chester L. Dawes, 1920. An up-to-date text-book by a practicing engineer.

Telephony

1. Automatic Telephony, by Arthur Bessey Smith and Wilson Lee Campbell. New edition now ready.

2. Automatic Telephone Systems, by William Aitken, an acknowledged British expert.

3. Modern American Telephony, by Arthur Bessey Smith. New edition about ready.

4. Telephonic Transmission, by J. G. Hill, 1920. Very thorough.

5. Telephone Apparatus, by George Defrees Shepardson, 1917.

6. Propagation of Electric Currents in Telephone and Telegraph Conductors, by J. A. Fleming, 1911. Gives the foundations of telephone transmission.

7. American Telephone Practice, by Kempster B. Miller, 1905. One of the best all around books.

8. Telephony—Theory and Practice, by Samuel G. McMeen and Kempster B. Miller, 1922. Similar to American Telephone Practice and much later.

Public Relations

1. Winning the Public, by S. M. Kennedy. The master book on public relations.

Radio

1. Wireless Experimenter's Manual, by Elmer E. Bucher, 1920. Very good for beginner who knows electricity and wants to make his own set or parts.

2. Radio Communication — Theory and Methods, by John Mills, 1917. Good, but rather mathematical.

3. Principles of Radio Communication, by J. H. Morecroft. Recommended for the student.

4. Principles Underlying Radio Communication, Second Edition, Signal Corps, U. S. Army, 1921. A handbook, comprehensive.

5. Radio Phone Receiving, by eight specialists, 1922. The best book for the beginner, and also valuable to the advanced student.

## *Department's Telephone System*

Substantial savings have been effected in the U. S. War Department telephone system, since the signing of the Armistice, many economies having been accomplished even since the Department business reached a normal peace-time basis.

At the height of war time operation, December, 1918, there were 133 employees in connection with the War Department switchboard, which was the largest private switchboard in the world. At present, only 18 are so employed, at a yearly cost of $22,000.

This reduction has kept pace with the reduction in service. In December, 1918, the War Department switchboard functioned for 5,030 telephones, with 2,100 extensions, at a cost for that month of $36,000. In June, 1923, 568 telephones and 208 extensions cost $1,764.26.

The department's yearly bills for telephone service show the following decline in cost, a decline which was ments are again calling attention of the Army in 1920 and under peace-time conditions: 1919, $338,904.60; 1920, $163,235.09; 1921, $66,345.34; 1922, $32,777.97; 1923, $23,461.66.

## *New England Operators' Strike Expensive to Operators*

Boston, Mass.—At 3 p. m., July 26 the telephone operators' strike in New England was called off by Julia S. O'Connor, president of the telephone operators' department, International Brotherhood of Electrical Workers. The month's strike is estimated to have cost the union $240,000 in wages, and subjected the operators to severe newspaper criticism because of the operators' lack of consideration for public welfare.

Reinstatement of the operators with loss of their seniority rights as offered by the New England T. and T. Co. was almost unanimously accepted by the striking operators.

## *W. B. Shank, Newark, O., Veteran Takes Well Earned Vacation*

Newark, Ohio.—W. B. Shank has resigned as supt. of construction of the Newark Telephone Co. With the exception of about three years spent in the service of the Jones and Winter Construction Co., and with the United States Long Distance Telephone Co., Mr. Shank has been with the Newark company since July, 1898. He is moving to California, but has made no announcement of his future business plans.

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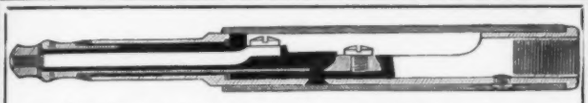

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ALL DISTURBED AND MOISTURE EFFECTED EARTH IS BACK OF THE NEVER CREEP

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No "pull" can make this anchor waver a bit in its fidelity to your interests.

It has a heart of iron, it is strong and long-lived.

It stays where you want it to stay, and goes there without any great expense.

It's the only anchor with the Thimbleye—the improvement that preserves the guy wire and makes installation easy.

This space won't permit the whole story but our booklet does—want it?

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**5100 Superior Ave., Cleveland, Ohio**


### *Crossing Stands Flood Test*

Oklahoma City.—Southwestern Bell officials think they have learned how to construct a river crossing that will stand up against any flood attack. The crossing over the South Canadian River near Mustang, Okla., had gone out regularly with former floods but the last time, about two years ago—engineers determined to erect a crossing that would not go out, if it were possible to do so. They sunk 14-inch steel casing through the river bottom to bed rock, which was at some places 60 feet down. They filled this casing with building steel reinforcing rods and concrete, setting 35-foot poles about ten feet down in the top of the casing. Two such poles were installed at a distance of about four feet from each other and were cross-braced with steel, the wire leads being placed on these structures across the entire river bottom area. When the recent floods began receding these structures were found intact and appear to have suffered no damage.

### *Telephoned Orders Legal*

In a case growing out of telephone orders to buy and sell stock, the District of Columbia Court of Appeals recently ruled that business done by telephone, telegraph or mails is just as binding as though parties stood face to face, or had signed contracts or written orders.


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